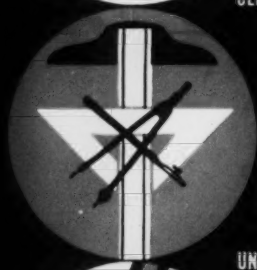
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • MARCH 1960

NEXT ASCE CONVENTION • RENO, NEV., JUNE 20-24, 1960

.....Why [illegible] is America's leading Technical Paper



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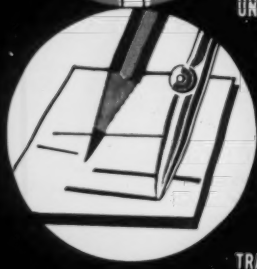

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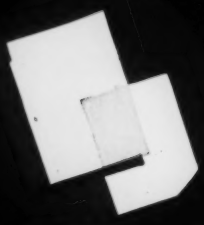

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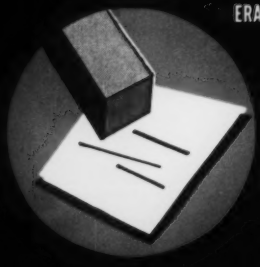

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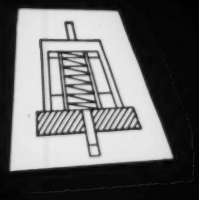

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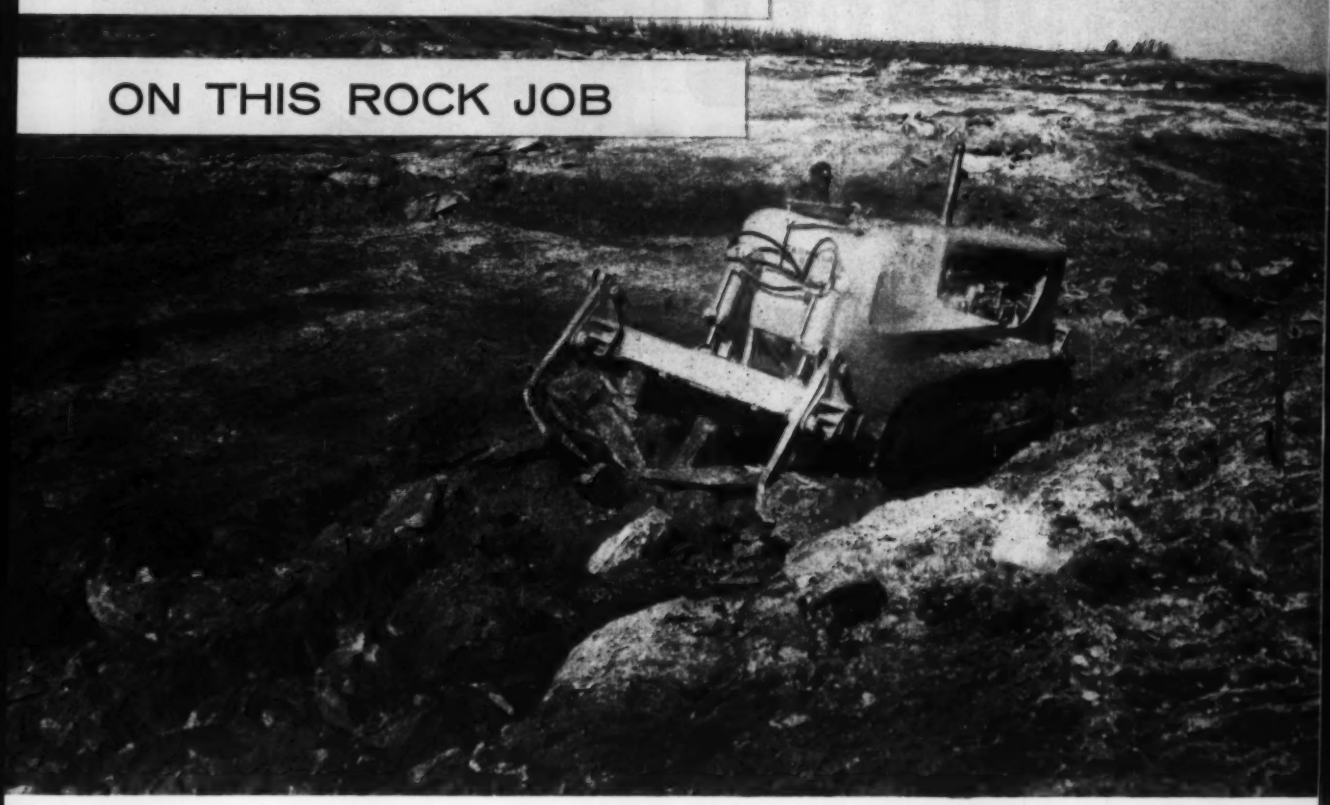
"FIRE IN THE HOLE"

A FORGOTTEN PHRASE

ON THIS ROCK JOB



If there's any yelling it's probably about the savings of ripping the rock rather than drilling and blasting.

This is Lee and Fox's job, U. S. Route 276 in Laurens County, South Carolina. They had to remove 70,000 cu. yd. —a large portion of it rock.

And that's where their D8 and No. 8 Ripper took over. The rock was torn up and shattered into pieces small enough to be loaded out in scrapers. That means *big* savings.

This one job isn't the whole story by any means. Just take a look at cost savings on different jobs, different materials, all over the country. (See chart at right.)

With the new heavy, powerful Caterpillar track-type Tractors and modern rippers, costs run about 35% to 60% of blasting costs — sometimes even as low as 11%! And there are more savings than that . . . a ripper shatters the material small enough that it can be loaded out with scrapers rather than with a shovel and trucks or wagons.

For a complete story on the economics of ripping see your Caterpillar Dealer. He knows the dollars and cents of ripping; he has the quality earthmoving equipment for your job. Ask for a demonstration.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

COST RELATIONSHIPS OF TYPICAL JOBS

Location	Material	Ripping Costs (Cents/Cu. Yd.)	Drilling and Blasting Costs (Cents/Cu. Yd.)
Tulsa, Oklahoma	Limestone	7.3	17.3
Dallas, Texas	Limestone	5.2	15.1
San Francisco, Calif.	Sandstone	15.0	30.0
Merriam, Kansas	Sandstone	2.1	11.7
Nelsonville, Ohio	Sandstone	5.7	13.8
Philadelphia, Pa.	Limestone	11.5	19.3
Carbo, Virginia	Sandstone	8.6	15.7
Hibbing, Minn.	Frost	25.0	60.0
Hibbing, Minn.	Paint Rock	6.1	54.5

The new D8 SERIES H — a modern track-type tractor giant. NEW turbocharged D342 Cat Diesel Engine — 235 HP (flywheel). BIG — 47,000 lb. operating weight. New 84" track gauge, new undercarriage. New common lube system for transmission, bevel gear and steering clutches. Power shift transmission optional.

CATERPILLAR

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DIESEL ENGINES
TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT

HERE'S HOW BORDEN FLOOR GRATING CUTS COSTLY FIELD CORRECTIONS

Insures correct dimensions, fit, and placement . . . .

1. A shop drawing of the job is submitted to the customer for approval, when necessary. This plan shows the size and shape of the grating area—how grating clears all obstructions.
2. Each finished panel is carefully checked for accuracy of dimensions.
3. Each panel is plainly marked with its number to insure quick, easy installation.
4. The entire platform is laid out on our shop floor. Overall dimensions and obstruction openings are checked against shop drawings.
5. Erection diagram showing panel mark numbers is supplied for field installation.

Write today for *free* 16-page catalog showing all basic types of grating; more than 30 dimensional drawings of subtypes; eight safe load tables for steel and aluminum grating.

BORDEN METAL PRODUCTS CO.

"greatest name in gratings"

845 Green Lane ELizabeth 2-6410 Elizabeth, N. J.

Plants at: Union, N. J. • Leeds, Ala.
Conroe, Texas • Beeton, Ontario

BORDEN METAL PRODUCTS CO.

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Please send me NEW 1960 BORDEN Catalog

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MARCH 1960
VOL. 30 • NO. 3

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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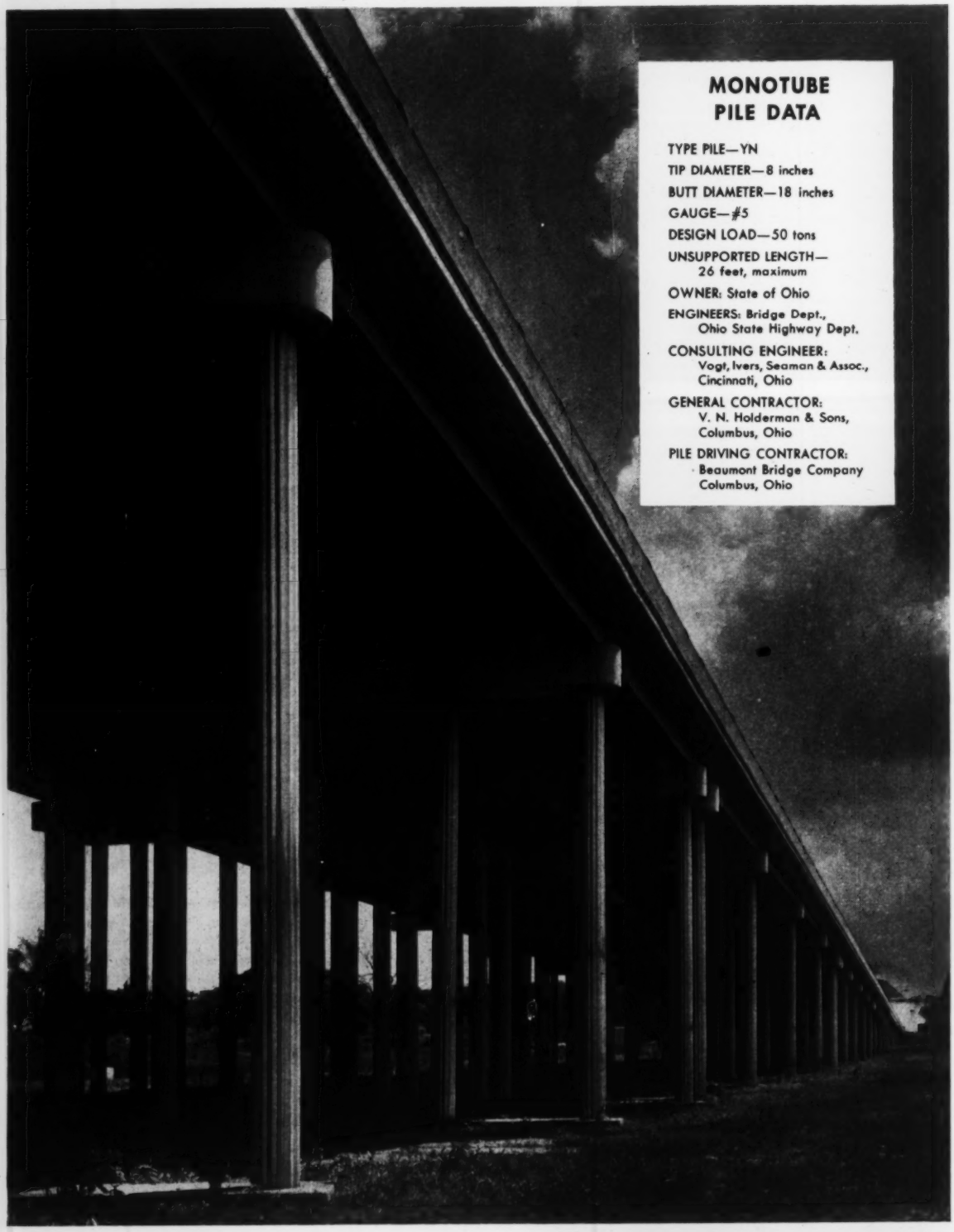


MONOTUBE PILE DATA

TYPE PILE—YN

TIP DIAMETER—8 inches

BUTT DIAMETER—18 inches

GAUGE—#5

DESIGN LOAD—50 tons

UNSUPPORTED LENGTH—
26 feet, maximum

OWNER: State of Ohio

ENGINEERS: Bridge Dept.,
Ohio State Highway Dept.

CONSULTING ENGINEER:
Vogt, Ivers, Seaman & Assoc.,
Cincinnati, Ohio

GENERAL CONTRACTOR:
V. N. Holderman & Sons,
Columbus, Ohio

PILE DRIVING CONTRACTOR:
Beaumont Bridge Company
Columbus, Ohio

VERSATILITY plus DESIGN ECONOMY

with Monotube piles. When soil conditions in Mansfield, Ohio, prohibited conventional construction in crossing low-lying land, this adaptation of a foundation supported on Monotube steel piles proved to be an economical solution.

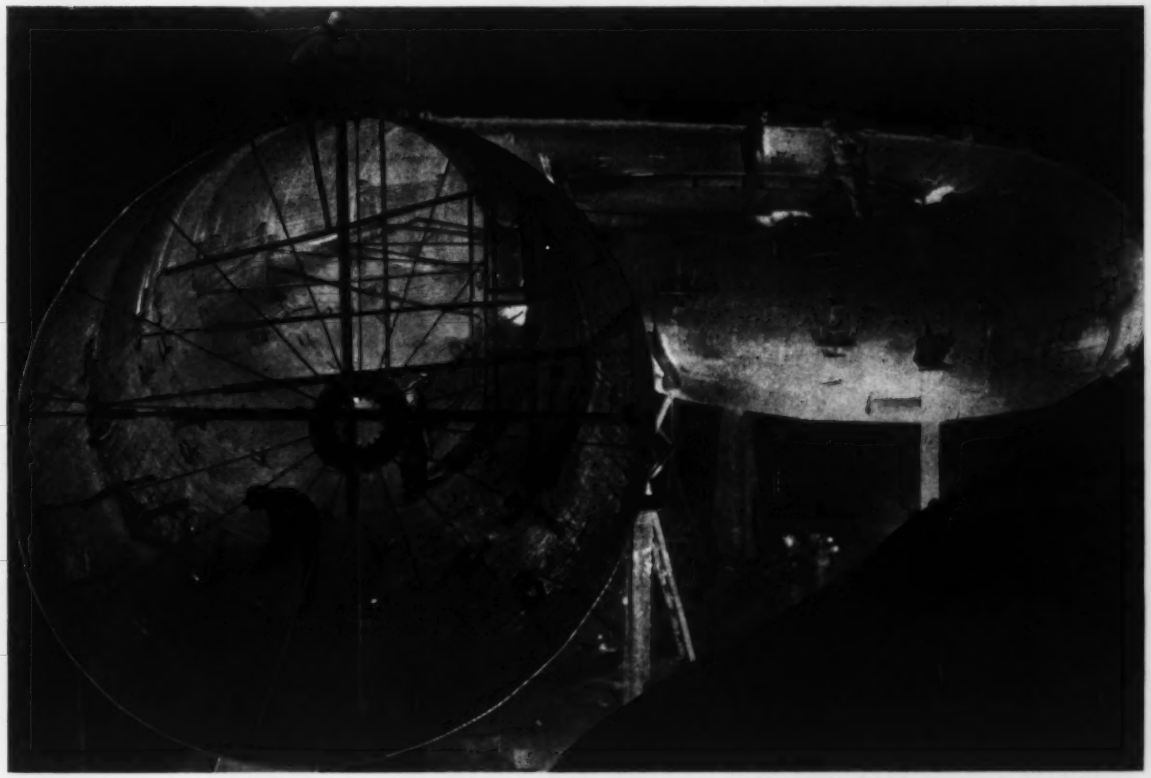
Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. The Union Metal Manufacturing Co., Canton 5, Ohio—Brampton, Ontario, Canada.

UNION METAL

Monotube Foundation Piles

ALLIS-CHALMERS

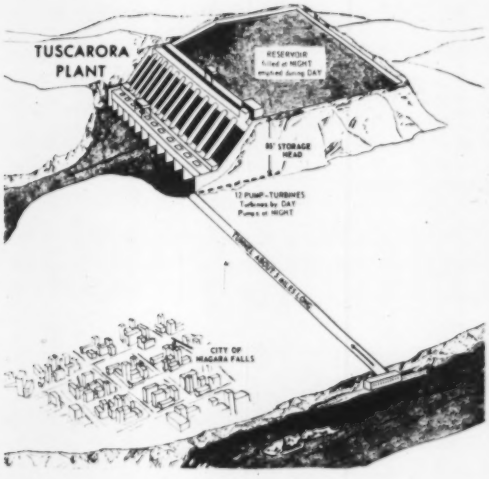
A-1231



THE BIGGEST MADE IN THE U.S.A., this reversible pump-turbine scroll case has inlet diameter of 18 ft, measures 56 ft across. It's designed for one of Tuscarora's 12 Allis-Chalmers pump-turbines.

Now building 12 reversible pump-turbines for Tuscarora—

world's largest pumped-storage project



Power plant by day, pumping station at night — the New York State Power Authority's Tuscarora plant will capitalize on the hydroelectric power potential of the Niagara River without adversely affecting the scenic beauty of the Falls.

The largest project of its kind, Tuscarora will have 12 reversible pump-turbines . . . all designed and fabricated by Allis-Chalmers. As a turbine, each of these units is rated at 28,000 hp under 75-ft head. In reverse, as a pump, each is rated at 3400 cfs against 85-ft head. All will be direct-connected to Allis-Chalmers generator-motors — rating 25,000 kva at .8 P.F. as generators . . . 37,500 hp at 100% P.F. in reverse as motors.

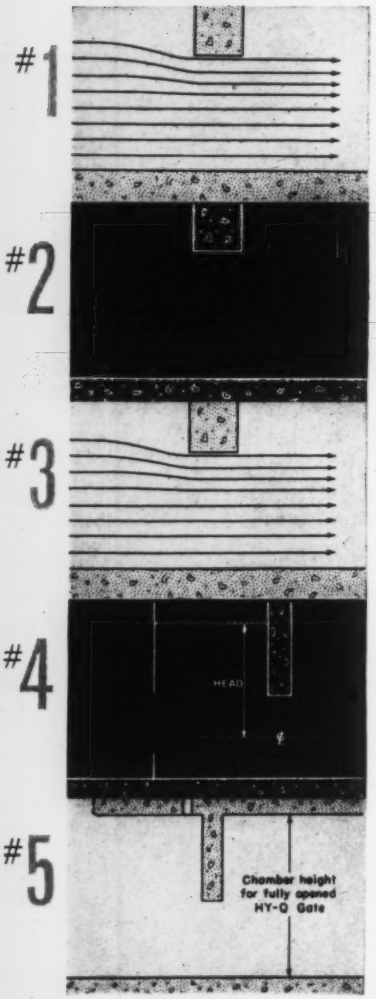
The selection of Allis-Chalmers to design and build the above components came naturally. A-C is the only builder of complete reversible pump-turbine installations — with a record that includes the world's largest pumped-storage projects.

Look to Allis-Chalmers for leadership in the design, engineering and manufacture of hydraulic turbines and necessary accessories such as valves, pumps, trash rakes, water control gates and hoists. *For information, contact your nearby A-C office . . . or write* **Allis-Chalmers,** *Hydraulic Division, York, Pa.*

#6

SPECIFY RODNEY HUNT
HY-Q SLUICE GATES WITH FLUSH-BOTTOM CLOSURE
and get these **6** design advantages

HY-Q® Sluice Gates Mean Construction Economies



Because of the improved flow characteristics of the Rodney Hunt HY-Q sluice gate, a given volume of flow can be handled with a smaller gate size, narrower channel and lower channel walls than are required for a conventional gate. Thus there are often substantial economies effected in concrete construction. This improved flow is the direct result of the 5 other design advantages of the Rodney Hunt HY-Q sluice gate:

#1 HY-Q Sluice Gates Assure Maximum Flow

#2 HY-Q Sluice Gates Assure Complete Drainage

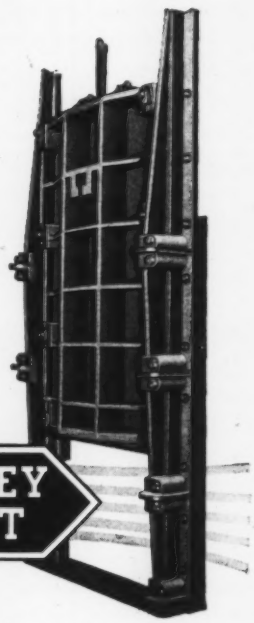
#3 HY-Q Sluice Gates Eliminate Interference with Flow

#4 HY-Q Sluice Gates Assure Maximum Hydraulic Gradient

#5 HY-Q Sluice Gates Permit Lowest Possible Invert

All these advantages derive from the design of the resilient seal fastened to the bottom of the disc. The seal extends the full width of the disc and provides a cushioned closing at the stop bar flush with the invert.

The HY-Q gate offers unmatched design flexibility and construction economy for water control projects . . . with hundreds of gate sizes available from 6" x 6" to 144" x 144" and larger to meet your specific design requirements.



HY-Q SLUICE GATE
a product of
RODNEY HUNT MACHINE CO.
Water Control Equipment Division
86 Water Street, Orange, Mass.
Serving water control engineers with equipment and engineering

RODNEY HUNT

ALLIS-CHALMERS

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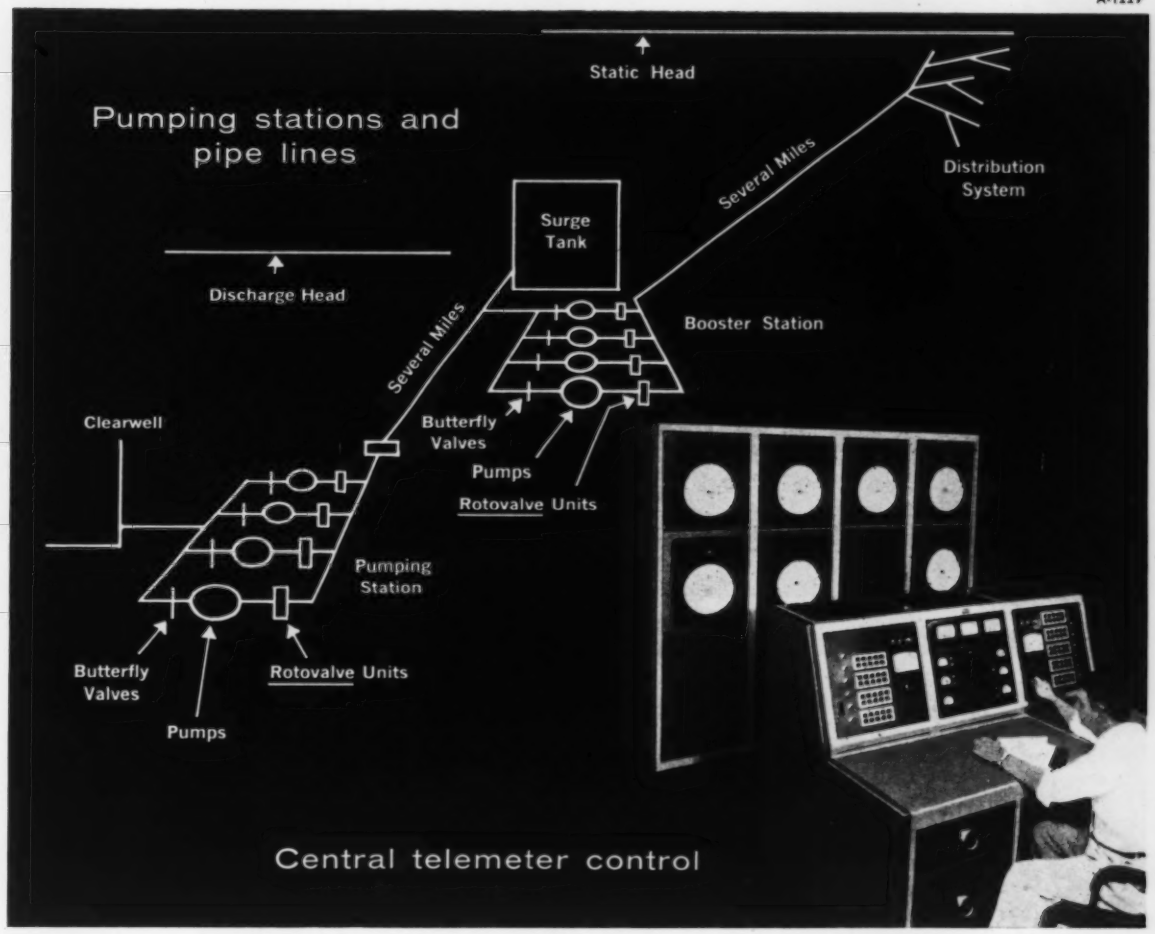


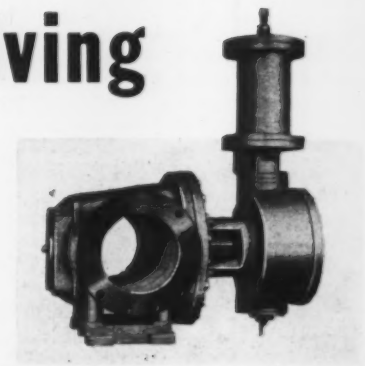
One man controls 60 mgd with

telemetered valving

Pumping stations operate completely unattended, controlled from a central remote console in this major water procurement and distribution system. Rated for 60-mgd peak load, it distributes over a 100-square-mile area from widely separated stations and storage tanks.

This is another dramatic example of complete valving service offered industry by Allis-Chalmers. Whatever you're dealing with, liquids or gases, including highest temperatures and pressures — Allis-Chalmers is your convenient source of today's most comprehensive rotary valve line. Types and sizes cover virtually every need . . . including *Rotovalve* units, butterfly and wafer valves and ball valves. We can also assist you in every phase of planning, engineering and installation. *Contact your Allis-Chalmers representative, or write* ***Allis-Chalmers,*** *Hydraulic Division, York, Pa.*

Rotovalve is an Allis-Chalmers trademark.



Key to a superior valving system, Rotovalve **units offer the least pressure loss . . . ideal flow characteristic . . . controlled timing . . . positive seating . . . easy operation always.**

900 feet installed in under 3 hours

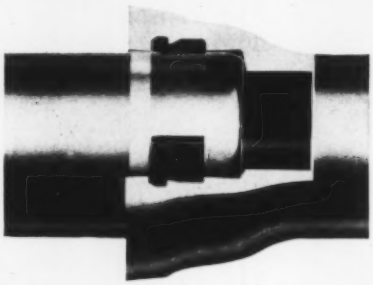
with time out for lunch!

As fast as trenching machines will operate . . . that's how fast it is to install AMERICAN FASTITE® Joint pipe! Numerous case histories verify this. For example, on a Southern suburban water supply system recently, 900 feet of 6-inch AMERICAN FASTITE® Enamelined pipe in 16-foot lengths was installed in under 3 hours . . . including time out for lunch. The entire operation required a minimum of labor and equipment and resulted in maximum installation economies.

The secret of this speed is in the simple 3-step assembly: (1) Insert gasket; (2) Lubricate spigot; (3) Push pipe together . . . . and you have a permanent, bottle-tight installation!

Your nearby American Cast Iron Pipe Company representative will prove why AMERICAN FASTITE® is the right joint pipe for your next job. Call him now.

AMERICAN
Fastite **JOINT**
CAST IRON PIPE



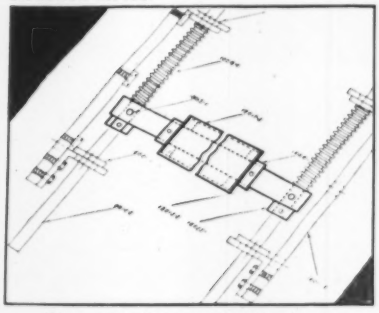
★ Fast Installation
★ Adequate Deflection
★ Leak Free

AMERICAN
CAST IRON PIPE CO.
BIRMINGHAM ALABAMA

SALES OFFICES
New York City • Dallas
Chicago • Kansas City
Denver • Pittsburgh
Orlando • Minneapolis
Cleveland • Birmingham

Ever Want Prints Emphasizing Parts of a Drawing?

Engineers, architects and many other types of technical people often want prints that separate key parts of a drawing from the rest of it, and some weird and costly techniques have been used. This is understandable because the cost of *not* getting good separation or emphasis can also be shocking. Take the case of a large West Coast engineering organization constantly involved in plant construction. They used sepia prints of floor plans to lay out the electrical work. But the lack of contrast between the plumbing shown in the sepias and the electrical layouts added required hours of careful checking and frequent revisions, even caused some expensive construction errors.



Diazo print from special-blue image intermediate produces a sharp contrast between the parts to be emphasized and those to be subdued.

That's all ancient history now! Two of Dietzgen's numerous modern drafting-printmaking aids have turned this tough old chore into a picnic. They are new drafting media (one a polyester film and the other a vellum) diazo sensitized to produce a special blue image. The reproduction of your basic drawing on either of these media is bold and clear so drafting additions can be made without confusion or error. But when you make prints from the completed intermediate, the basic part in the special blue prints faintly (clearly visible but subdued) . . . while the added drafting, even in pencil, prints strong and bold. The results are perfect, easily and quickly obtained, delightfully inexpensive.

SOLVED: A COSTLY PROBLEM OF COMBINING DRAWINGS AND GRAPHS

Drafting time costing as much as $40 was used to draw a single grid . . . and draftsmen resented the tedious assignment.

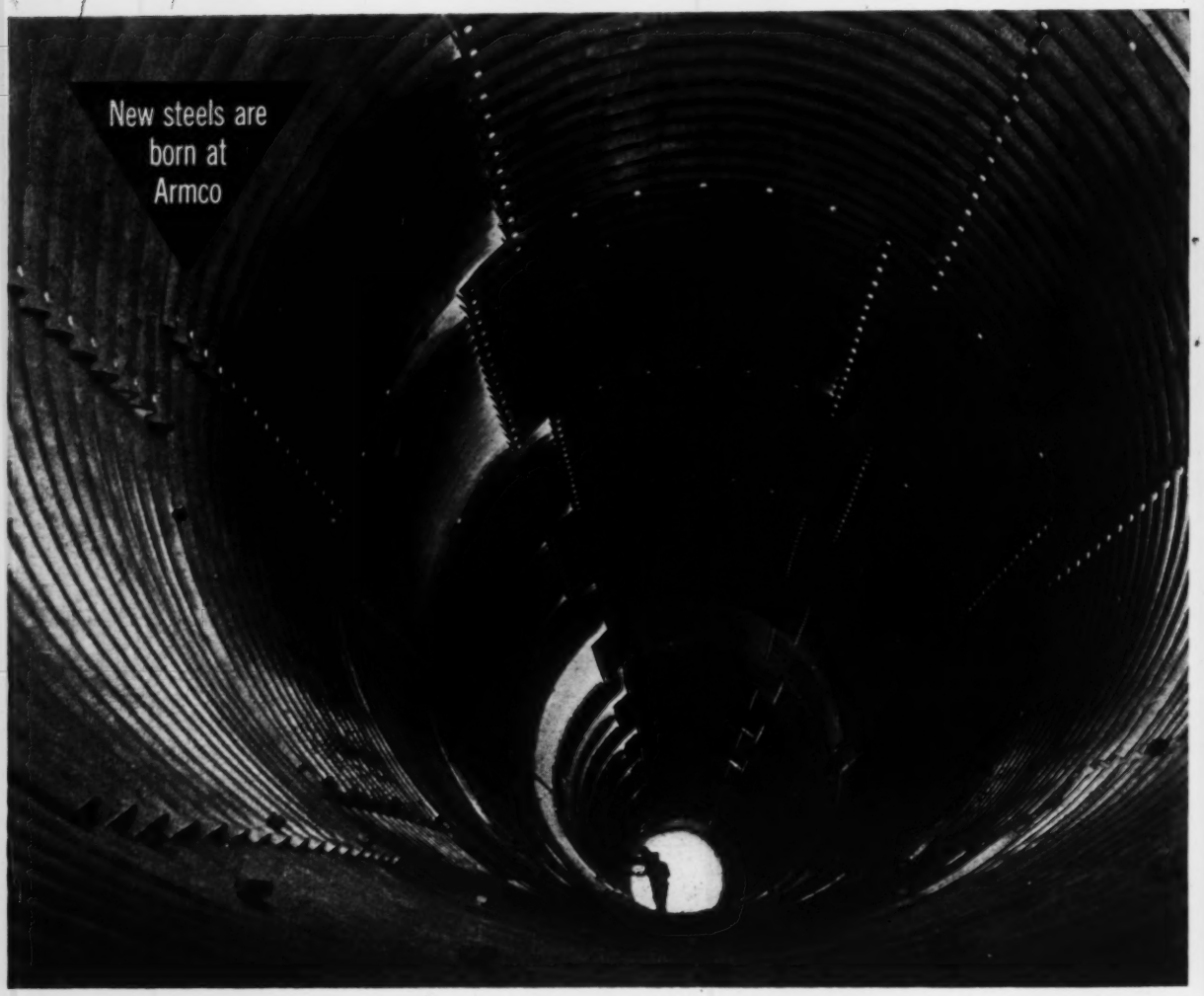
A large manufacturer of automotive parts decided to plot their graphs directly on the drawings in order to end the nuisance of their being separated in handling, filing, plant interchange, etc. But this created many new problems. Tracing or drawing the grids in position proved costly, as much as $40 each in drafting time. They were rarely accurate and never uniform in character. The lines often smudged and usually reproduced poorly. The work created a morale problem because draftsmen resented the tedious assignment.

One of Dietzgen's modern drafting-printmaking aids furnished a perfect answer! It is a light-weight drafting film which is adhesive-backed and furnished printed with a stock grid. It is simply mounted in place and the grids are sharp, clean, clear and uniform, so much more accurate that fewer plotting points are needed to develop the graphs. Reproductions were so noticeably better as prints moved through other departments and associated plants that the change was investigated and quickly adopted. Much needed drafting time and capacity is saved and the reduction in costs amounts to many thousands of dollars a year.

Drafting-Printmaking Handbook reports new techniques for solving engineering and production problems

This new 36 page handbook describes a wide variety of engineering and production problems that have been solved with advance techniques in drafting and printmaking pioneered by Dietzgen. The concise, problem-solution approach suggests ways in which you may improve the efficiency within your engineering department or eliminate production bottlenecks. Write today on your company letterhead for the Mechanics of Modern Miracles. Ask for Publication SPD2-C-81 Eugene Dietzgen Co., Chicago 14, Illinois.

THIS BIG ARMCO



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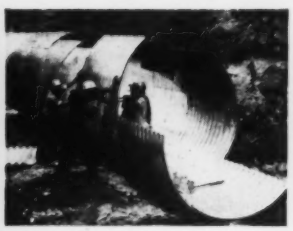

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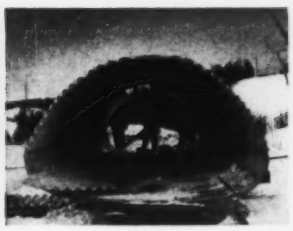
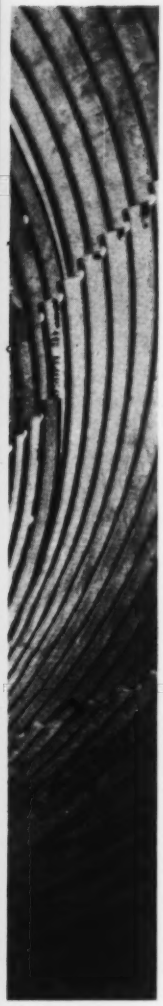


4

1. This conveyor tunnel is an Armco MULTI-PLATE Pipe. 2. Easy-to-handle MULTI-PLATE sections are bolted together quickly. 3. Battery of bituminous-coated MULTI-PLATE Structures provides large drainage area. 4. Pipe-Arch is one of a variety of shapes of MULTI-PLATE Structures. 5. MULTI-PLATE Pipe serves as pedestrian underpass in railroad yard.

DRAINAGE STRUCTURE won't crack or break



Properly installed, an Armco MULTI-PLATE® Drainage Structure functions as a *single unit*—for good. The curved, corrugated plates are bolted together to make an integral structure. Transverse earth pressures can't disjoint it. Frost action won't crack it. Imposed loads will not break it. This means an Armco Structure will be as strong, as straight and as sound 20, 30, 40 or more years from now as the day it was installed.

Best of all, Armco MULTI-PLATE is the *most economical* answer for large size drainage structures, underpasses, conduits and similar needs, time after time. Actual job service records prove it.

You can get complete facts easily. Use the coupon for your copy of the Armco MULTI-PLATE Catalog. If you want to discuss the application of MULTI-PLATE to your specific problem, our representative will be glad to show you factual case histories. Armco Drainage & Metal Products, Inc., 4320 Curtis Street, Middletown, Ohio.

SEND FOR FREE CATALOG

TWENTY PAGES OF AUTHORITATIVE DATA

ARMCO DRAINAGE & METAL PRODUCTS, INC.
Department G
4320 Curtis Street, Middletown, Ohio

Rush my copy of the Armco MULTI-PLATE Catalog.
☐ Have representative call.

Name_____

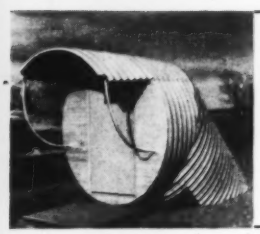
Title_____

Organization_____

Street or box number_____

City_____ Zone_____

State_____



Armco MULTI-PLATE Structures are part of a complete line of corrugated metal drainage structures offered by Armco. Others include Armco Corrugated Metal Pipe and Pipe-Arch, SMOOTH-FLO® Sewer Pipe, and Perforated Subdrainage Pipe. MULTI-PLATE is used where large openings are required. Diameters range from 60" to 180".

5

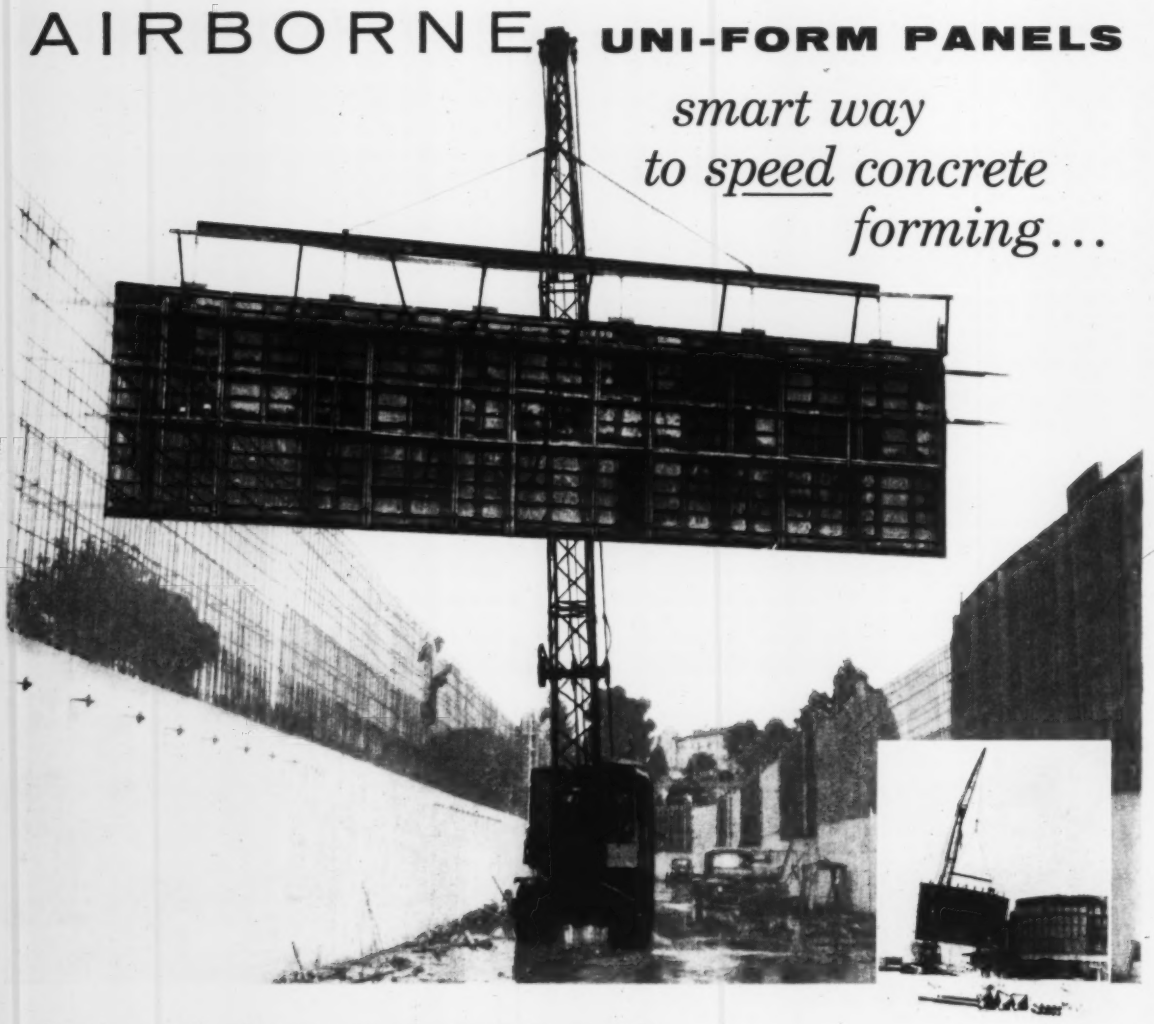
ARMCO DRAINAGE & METAL PRODUCTS

Subsidiary of ARMCO STEEL CORPORATION

OTHER SUBSIDIARIES AND DIVISIONS: Armco Division • Sheffield Division • The National Supply Company • The Armco International Corporation • Union Wire Rope Corporation

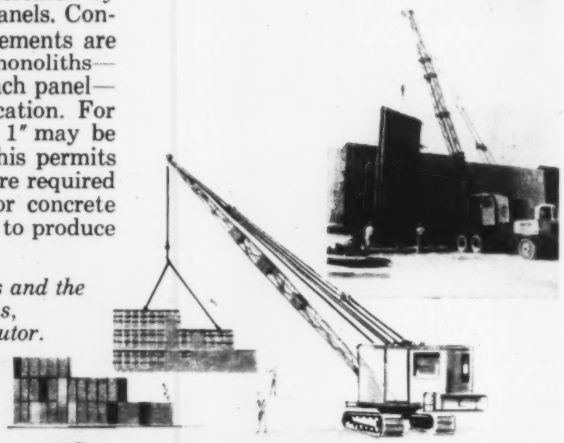
AIRBORNE UNI-FORM PANELS

smart way to speed concrete forming...



Forming speed and economy can be greatly increased by crane handling big monoliths of UNI-FORM Panels. Contractors with repetitive section forming requirements are finding that the design of UNI-FORM Panel monoliths—in which metal filler angles are used between each panel—give them greater versatility and wider application. For example . . . tie rods of any size from ½" to 1" may be used to tie two monoliths into a wall form. This permits using the right tie size for the job. Fewer ties are required and sections can be placed, tied and ready for concrete faster. Panels may be added or removed at will to produce any monolith required.

For complete information on UNI-FORM Panels and the UNI-FORM System in crane handling operations, write today, or ask your nearby Universal Distributor.



"Products from the Gold Tool Room"

UNIVERSAL FORM CLAMP CO. 1238 N. KOSTNER AVENUE • CHICAGO 51, ILLINOIS

BRANCH OFFICES and WAREHOUSES:

ATLANTA BALTIMORE CLEVELAND HOUSTON
LOS ANGELES SAN LEANDRO TORONTO

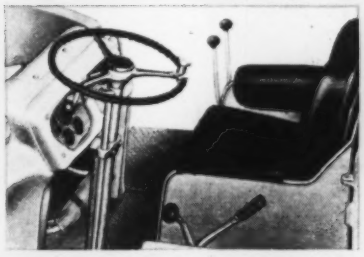
BRIEF SPECIFICATIONS

Bucket capacity, 2 cu. yd.; bucket reach, 50¾ in. (@ 7 ft. dump height); over-all width (bucket), 93½ in.; wheelbase, 88 in.; speeds, forward (4), 0-24 MPH . . . reverse (4), 0-30 MPH; shipping weight, with diesel engine, 20,780 lb. — with gasoline engine, 20,440 lb.

HIGH LIFT, extra-long reach and safety! Note how bucket lift arms are completely in front of operator's area. This gives him new freedom of movement and greater all-round visibility. Other safety features: wide steps for safe and easy access from either side. Plus wide fenders that provide a handy engine checking platform as well as protection for operator from rocks and mud.

NOW! The No. 944

. . . the Cat wheel-type Traxcavator
. . . the first of a New Wheel Loader Line



DESIGNED FOR ACTION, controls provide instant, finger-tip shifting . . . a full range of work and travel speeds with reverse speeds 25% faster than forward speeds. Travel Range gives 2-wheel drive for roading . . . Work Range automatically puts power to all 4 wheels. Other action features: conveniently located machine and bucket controls . . . forward-reverse lever on the steering column . . . both bucket control levers with kick-out devices. Lift control releases at dumping height — tilt control positions bucket for digging.

DESIGNED FOR PRECISE CONTROL, the No. 944 brake system is outstanding. The left brake neutralizes the transmission as it stops the machine to provide superior loading action. The right brake leaves the transmission engaged for full control when creeping, etc.

VERSATILE IS THE WORD for the Cat No. 944 Traxcavator, which is offered with a full line of attachments and accessories to multiply its usefulness to you on any job. Available are forks, cab (shown here) and special buckets, including the exclusive side dump bucket.

Here's the first of a completely new line of equipment . . . the Cat No. 944 . . . rated at 2 cu. yd. capacity . . . that will soon include the No. 922 (1¼ cu. yd. bucket) and the No. 966 (2¾ cu. yd. bucket).

Watch for these new machines with the bold new design . . . they're ready to bring new standards to wheel loader operation. Take a look at the big new features that make this the easiest and fastest wheel loader to operate. Every feature is designed for *efficient work.* Plenty of horsepower . . . finger-tip steering . . . smooth, fast bucket action . . . outstanding operator comfort and safety.

Choose from two great new engines . . . the compact 4-cylinder Cat D330 Diesel Engine, turbocharged for maximum efficiency . . . or the 6-cylinder gasoline engine. Both are 105* HP units. Whatever your requirements, there's a No. 944 powered to meet your needs. Get the complete facts on the No. 944. See your Caterpillar Dealer the week of March 14. See for yourself how the new design pays off on your loader jobs!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

*For comparative purposes, the maximum rating of the Caterpillar D330 Diesel Engine used in the No. 944 is 135 horsepower.

CATERPILLAR

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

A GREAT NEW PRODUCT IN THE CATERPILLAR TRADITION

Completed Ahead of schedule with

REINFORCED CONCRETE

U. S. Highway 23 Interchange, west of Bay City, Michigan
General Contractor: Walter Toebe & Co. Lansing, Michigan

The Birch Run Interchange on U.S. Highway 23 near Bay City, Michigan, was *completed ahead of schedule*. This project is another example of how Reinforced Concrete helps engineers to keep pace with our constantly expanding highway and toll road programs.

For every type of highway structure, Reinforced Concrete provides a construction material of unusual flexibility and durability. And, because all materials and labor are readily available from local sources, projects start on time and finish on schedule.

CONCRETE REINFORCING STEEL INSTITUTE CRSI FOUNDED 1924

Concrete Reinforcing Steel Institute
38 South Dearborn Street, Chicago 3, Illinois

1-60

BIRD'S EYE VIEW OF RESPONSIBILITY

Driving pile foundations is just one aspect of Raymond's *single responsibility*. Of all the foundation organizations in the country only Raymond offers—and is solely responsible for—complete foundation service including soil investigation, pile manufacture, load testing and installation. When you specify Raymond foundations you receive the benefit and economy of having all the details handled expertly and efficiently by one company. On your next project, no matter how large or small it may be, employ Raymond's more than 300,000,000 man-hours of experience in providing all types of foundations. Get all the facts from the Raymond office nearest you, or write our main offices, 140 Cedar Street, New York 6, New York.

RAYMOND
CONCRETE PILE COMPANY

A Division of Raymond International, Inc.
140 CEDAR STREET, NEW YORK 6, N. Y.
Branch offices in principal cities of the United States. Subsidiaries in Canada, Central and South America and other countries around the world.

FOUNDATIONS FOR THE STRUCTURES OF AMERICA...COMPLETE CONSTRUCTION SERVICES ABROAD

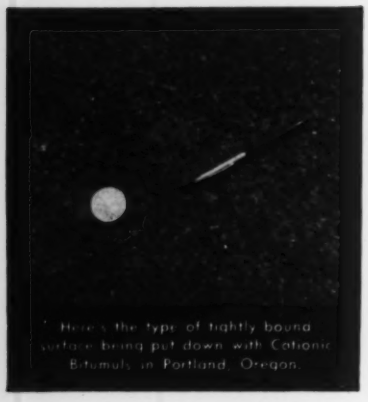
Portland Profits By Resurfacing Streets With CATIONIC BITUMULS

Distributor applies Cationic Bitumuls at 0.2 gal./sq. yd. Note "skirt," designed to protect against drift or splash.

Truck immediately applies 25 lbs. of cover stone (¼"-#10) using tail-gate spreader. Two passes by three-wheel steel roller completes job.

The City of Portland, Oregon, is about to complete its second successful season of Single Surface Treating city streets using Cationic Bitumuls.

Last year, Cationic Bitumuls was used on more than 80% of a total of over one million square yards of such work. Costs averaged out at about 12 cents per sq. yd. as opposed to 16½ cents for similar work using an asphaltic cutback. This year, the program will include at least 800,000 square yards. Conservatively, this means a saving of over **$70,000 in two years!**



Here's the type of tightly bound surface being put down with Cationic Bitumuls in Portland, Oregon.

WHERE THE ECONOMY DEVELOPS

According to officials in Portland, the savings can be traced to the following factors: less aggregate required; smaller crew; less binder; faster operation.

In addition, Cationic Bitumuls holds even siliceous aggregates. And it extends the working season because it gives extra protection against wash-off of binder when early rain is encountered.

FUTURE PLANS

Current plans call for a continuing program involving the resurfacing of 50 to 60 miles of streets each year. At this rate the City will continue to save approximately $35,000 per year as compared to earlier methods.

Investigate the benefits of using Cationic Bitumuls in your street and road work. Call our nearest office for full information, today. Your community, too, can **profit** just as Portland is doing.

American Bitumuls & Asphalt Company

320 MARKET, SAN FRANCISCO 20, CALIF.
Perth Amboy, N. J.
Baltimore 3, Md.
Cincinnati 38, Ohio
Atlanta 8, Ga.
Mobile, Ala.
St. Louis 17, Mo.
Tucson, Ariz.
Portland 8, Ore.
Oakland 1, Calif.
Inglewood, Calif.
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BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts

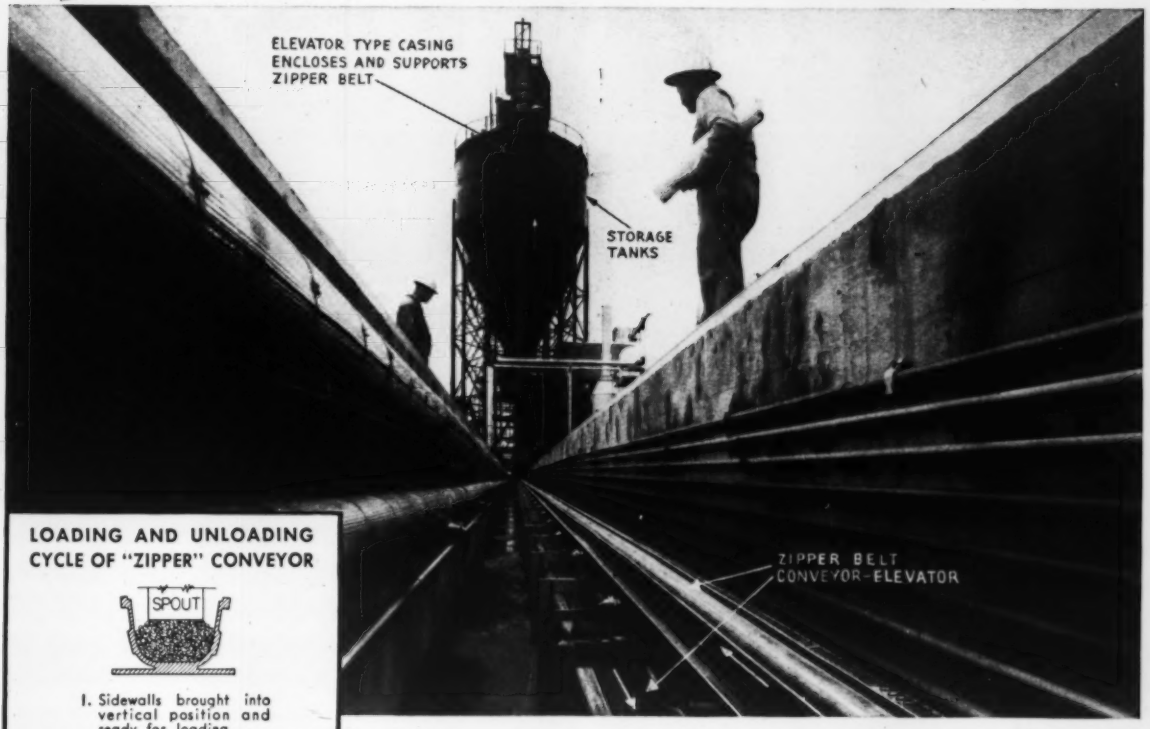
STEPHENS-ADAMSON

EXCLUSIVE

"ZIPPER"*

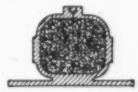
CLOSED-BELT

CONVEYOR-ELEVATORS



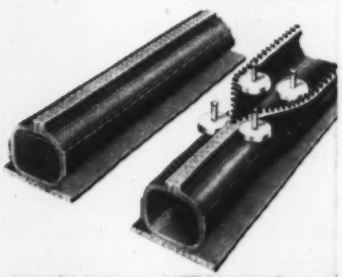
LOADING AND UNLOADING CYCLE OF "ZIPPER" CONVEYOR

1. Sidewalls brought into vertical position and ready for loading.



2. Flexible tube completely closed for conveying and elevating.

3. Rubber ZIPPER belt open for discharge, cleaning and return run.



Upper left unit closed and loaded. Lower right shows how belt is opened and closed by system of ball bearing rollers. (Rollers are mounted on a rigid framework)

CONVEYS AND ELEVATES BY CONTINUALLY WRAPPING MATERIAL IN A PACKAGE... MOVING THE PACKAGE AND ITS CONTENTS TO A NEW LOCATION AND GENTLY UNWRAPPING IT!

Literally a moving material-carrying conduit, the ZIPPER Conveyor is capable of transporting bulk materials in any plane, to considerable heights and around obstructions. Its great advantage is that bulk materials may be conveyed within the belt completely sealed and dust-tight. Material doesn't slide, isn't scooped, pushed or thrown but is gently carried over great distances without breakage, agitation or segregation. The ZIPPER Conveyor-Elevator provides versatility of layout and profitable material handling advantages you won't want to overlook.

*PATENTED

WRITE FOR BULLETIN 349

ENGINEERING DIVISION

STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT, 66 RIDGEWAY AVENUE, AURORA, ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

Your structural steel fabricator serves you in all these ways

CONSULTANT

What's new in steel technology? (Lots!) How does it contribute to better structures built more cheaply, more quickly? (In many ways!) Just ask your fabricator.

STRUCTURAL ENGINEER

Your fabricator knows the cost-saving "ins-and-outs" of every steel construction method. He knows when to use which—and he knows how to use it.

ESTIMATING ENGINEER

Your fabricator studies every cost factor. He'll incorporate every money-saving suggestion he can think of. Since he works with *steel*, he can think of plenty.

DETAILER

Your fabricator will prepare a final shop detail drawing for each part of an assembly to assure precision fabrication, precision fit—whether it's a 50-ton girder or a 500-pound floor beam.

FABRICATOR

Your fabricator will "tailor" the shapes you need—exactly the way you need them. He can help you capitalize on the full versatility of today's most *flexible* structural material—structural steel.

COORDINATOR

Your fabricator will deliver the fabricated structural steel—on the spot, on time. He'll schedule every production aspect of your job, ship finished parts in the right sequence.

ERECTOR

Your fabricator will erect the framework he fabricates for you—fast! His equipment and tools are modern; his crews are experienced. And what other structural material goes up as fast as steel?

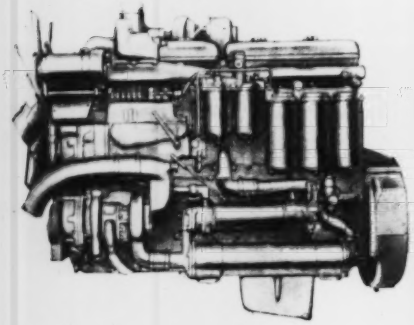
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

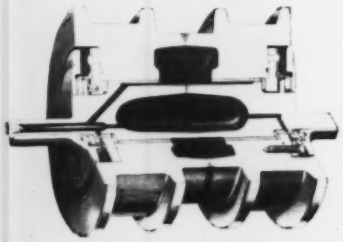
BETHLEHEM STEEL

Three new International TD-25's of contractor V. E. Posey's fleet team up preparing home sites from a mountainside...near San Diego, California. One "25" operator comments: "The power is there, but big engine 'sound and fury' are just about gone!"



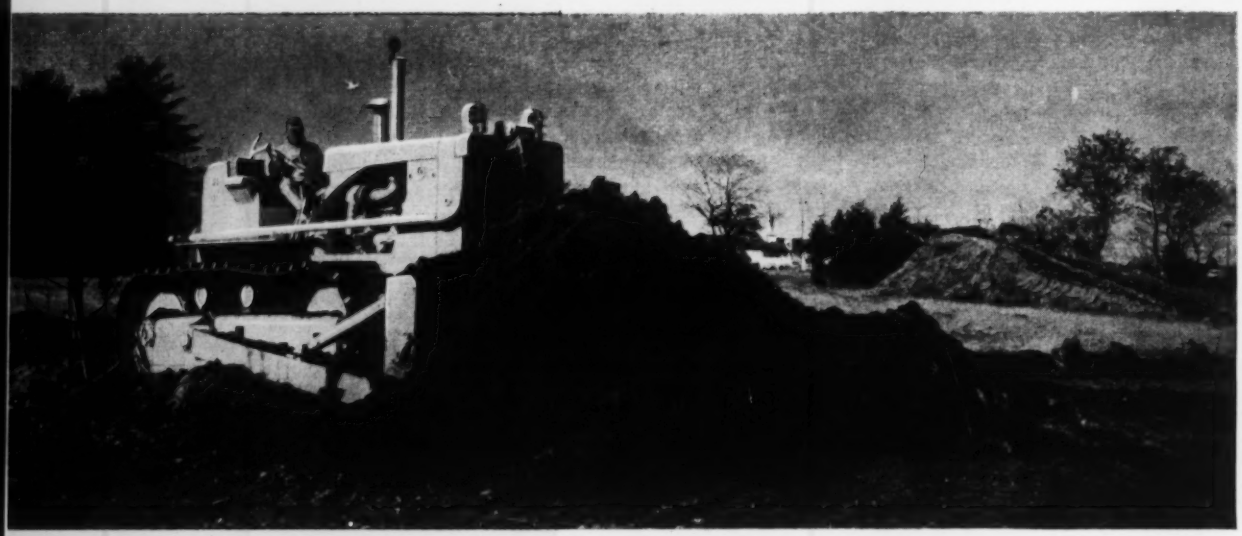
Big power "plus" of the new TD-25 is the new direct-start, 6-cylinder turbocharged International DT-817 diesel engine. Tri-metal crankshaft bearings; valve rotators; dry-type air cleaner; externally-mounted, gear-driven oil and water pumps—all are typical DT-817 long-life, high-output features!

How you get full-



Thick-shelled International Dura-Rollers have king-sized lube reservoirs, positive sealing, and exclusive relief-passage protection from over-lubrication. These *minimum maintenance* track rollers give you practical 1,000-hour lubrication intervals!

Keep full loads on the move full time with exclusive Planet Power-steering. Full power on both tracks, full time, is the answer! And Hi-Lo on-the-go power-shifting lets you match power to condition, instantly, to keep loads "on the move"—and increase speed where practical! This "25" belongs to Berke Moore Co., Inc., Boston expressway contractor!



load turns...full-speed cycles

with proved TD-25 standard equipment!

As standard equipment at no extra cost, the new 230-hp TD-25 gives you the International® proved control combination that has been outproducing king-sized clutch-steered crawlers for years!

You get combined Planet Power-steering and Hi-Lo on-the-go, power-shifting exclusively in the new International TD-25. And you get this basic, built-in design advantage in your choice of torque-converter or synchromesh model!

With this and all its other big advantages, the TD-25 can outearn other big rigs up to 50%—on push-loading, bulldozing, or pulling big drawbar tools such as a shale-shattering ripper!

No "dead-track drag" or "gear-shift lag"!

Planet Power-steering gives you full-time "live" power and traction on both tracks, to make full-load turns—and to eliminate load-limiting "dead-track drag." And Hi-Lo on-the-go power-shifting instantly matches power to conditions to end load-losing "gear-shift lag."

Hi-Lo power-shifting makes the TD-25 the industry's only king-sized 4-speed torque-converter crawler, and the only one with load-matching efficiency-range control. In the synchromesh transmission "25," the Hi-Lo planetary system gives eight speeds forward and reverse. Either model gives you cycle-speeding, up-or-down, on-the-go power-shifting with "finger-tip" ease!

Power-shift and power-steer the new "25" with king-size loads—around curves, upgrade, anywhere. Prove what it means to command full-time, full-load ability to outearn clutch-steered king-sized crawlers, up to 50%—and with standard control equipment! Compare simplified TD-25 design—the only planetary system engineered and located to give you "live track" power steering and on-the-go, up-or-down power shifting! See your International Construction Equipment Distributor for a demonstration!

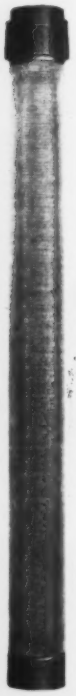
International® Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

When You're Pondering
COMPARE

There's more to a Moretrench Wellpoint than meets the casual eye. As this cutaway view of our standard 2" self-jetting model indicates, a Moretrench Wellpoint is a skillfully-engineered tool.

◀ The economy model — Moretrench 1½" Self-Jetting Wellpoint



◀ For high capacity — Moreflow Wellpoint, Drawdown-Type

◀ For very high capacity and pressure relief — Moreflow Wellpoint — Open-Type

◀ Low-Cost expendable model Moretrench Type X Wellpoint

Special Types of Moretrench Wellpoints

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Pumping Equipment

POINTS as well as PRICES...

Ask our sales engineer to show you the construction of a MORETRENCH WELLPOINT.

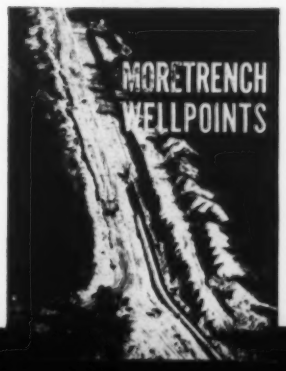
You'll see at a glance why experienced contractors pay *more* for Moretrench. They GET more . . . every time. Here's why:

MORETRENCH WELLPOINTS ARE:

1. Better made.
2. Built with a larger, unblocked water-passing screen area.
3. Easily and properly installed.
4. Practically clog-proof.
5. Specifically designed in five different types for the most efficient dewatering of various types of soil.

Fewer points dry the job. Installation, operation and removal costs are proportionately lower. Results are immediate. You are free to dig as fast as you like — by any method you like — IN THE DRY.

In pumping it's the *FINAL COST* that counts. Moretrench Wellpoints cost a little more, *save much money.* Get the best — first.



To know more about Moretrench Wellpoints and their special applications, send for our new illustrated bulletin — MORETRENCH WELLPOINTS.

MORETRENCH CORPORATION
ENGINEERING DEPARTMENT, ROCKAWAY, NEW JERSEY

Please mail me a copy of your new bulletin, Moretrench Wellpoints.

*Name*_____

*Company*_____

*Address*_____

NEWS OF MEMBERS

Daniel P. Jenny, for ten years a structural engineer with the Portland Cement Association, has been added to the staff of the Expanded Shale Clay and Slate Institute as chief engineer in the Washington, D. C. office. His recent work with the Washington office of the Portland Cement Association has included short course lectures and discussions on the subjects of thin-shell, ultimate strength, as well as prestressed concrete design.

Carlos A. Weber, one of the nation's top road design experts, retired on January 4 as chief engineer of the Michigan State Highway Department to become vice-president of a Lansing, Mich., construction supply firm. Connected with the department since 1920, Mr. Weber played an active role in the state's two major road construction programs. As chief road engineer, from 1945 to 1953, he supervised both the design and early construction of the Edsel Ford and John C. Lodge expressways in Detroit, Michigan's first limited access highways.

Harvey O. Banks, director of the California Water Resources Department, was elected chairman of the Interstate Conference on Water Problems for the coming year at the organization's recent annual meeting in Chicago. First vice chairman is **Robert L. Smith,** executive secretary of the Kansas Water Resources Board, while **William C. Ackermann,** chief of the Illinois State Water Survey, is secretary-treasurer. The purpose of the group is to enable states to give mutual assistance in solving water problems through exchange of information.

W. R. Holway, founder of Tulsa, Oklahoma's oldest engineering firm, W. R. Holway and Associates has joined with the principals of another Tulsa firm, Cornett, Wood and Associates, to form Holway Engineers, Inc., with offices in Tulsa. Officers of the new firm include W. R. Holway as president; **Jack B. Cornett** as vice-president; and **W. N. Holway** as treasurer.

Callix E. Miller, since 1951 a member of the staff of International Minerals & Chemical Corporation has been promoted to director of the company's Facilities Administration. Recently, he was staff manager of special projects for IMC and was in charge of architectural planning for the company's Administrative and Research Center in Skokie, Ill., completed in 1958.

Russell S. Fling, consulting engineer of Columbus, Ohio, announces the addition to his firm of **Gunnar Eeman** as an associate engineer under the firm name of Russell S. Fling & Associates. Mr. Eeman's previous experience includes ten years in Toledo, Ohio, in the offices of Bellman, Gillett & Richards and Raymand C. Reese.

John J. Niland, who joined the Stone & Webster Engineering Corporation, Boston, Mass., in 1941, has been made the firm's assistant engineering manager. Named design engineer in 1950, he was promoted to senior design engineer in 1953, and since 1956, has served as assistant to the president of Associated Nucleonics, Inc., a subsidiary of Stone & Webster engaged in atomic energy work.

choice

...based on responsibility...

...can make a difference...

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G. O. Wessenauer, manager of power for the Tennessee Valley Authority at Chattanooga, Tenn., recently announced organizational changes in his office as part of TVA's expansion program for the region. **W. B. Richardson,** who has headed TVA's construction and maintenance activities, will be in charge of the Power Construction Division; **R. L. Forshay,** who has been personnel officer in the Office of Power, will head the Management Services Staff; and **R. A. Kampmeier,** in addition to his present post as assistant manager of power, will also serve as acting head of the Financial Planning Staff.

Charles T. Blair, until recently a partner in Wilsey & Ham, engineers and planners, is now vice-president and chief engineer of the firm under its new name of Wilsey, Ham and Blair, with offices in San Francisco and Los Angeles. As a result of the reorganization, division managers **Gordon Tillson** and **Jack E. Van Zandt** have been made partners with the titles of vice-president. Mr. Blair is the new president of the Bay Counties (Calif.) Civil Engineer and Land Surveyors Association.

Eugene A. Krannich, since 1956 a member of the consulting firm of Sauter, Ritchie & Doane of Cuyahoga Falls, Ohio, has been advanced to associate engineer. Mr. Krannich will supervise the design department in his new post.

John P. Riley, internationally known construction engineer, has been appointed vice-president for development of Lockwood, Kessler & Bartlett, Inc., of Syosset, N. Y. Mr. Riley joined the firm last year after three years as vice president and chief engineer of the Ibec Housing Corporation. As chief engineer and director of development of the New York City Housing Authority, for several years, Mr. Riley directed over $750 million of construction, and as special coordinator of New York City's school construction program he directed construction of $100 million worth of new schools.

Earnest Boyce has obtained a leave of absence from the University of Michigan where he is a professor and chairman of the department of civil engineering to lead a study of sanitation and water supply problems in villages of India during February, March and April, 1960. In the past Professor Boyce has served with the World Health Organization as a consultant in sanitary engineering in other Asian countries and for seventeen years was Kansas state sanitary engineer. Another member of the team is **Dwight F. Metzler,** chief engineer, of the Kansas State Board of Health.

(*Continued on page 27*)

six steps help you

How many companies do you deal with when ordering pipe for your waterline? How divided is the responsibility for final performance? How easy is it to keep deadlines?

In the west, *only Southern Pipe* offers six steps to help you solve these and other problems of choice in buying water pipe. In short, Southern Pipe will save you money, cut red tape, eliminate worries—*by assuming all responsibility.*

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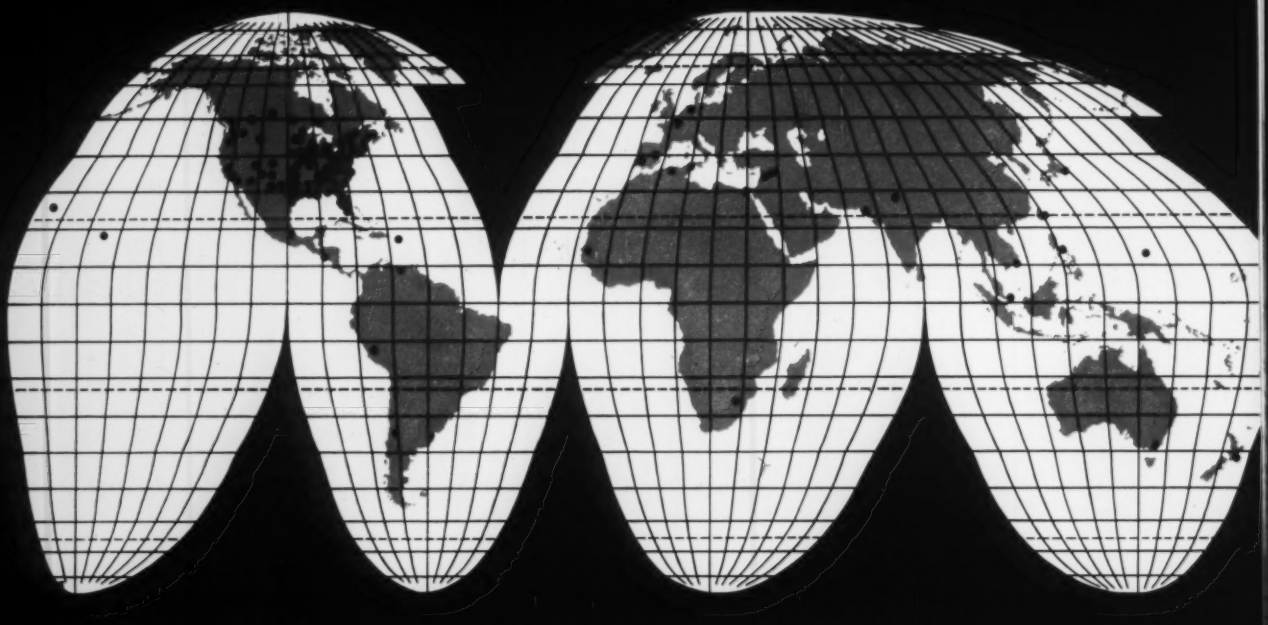

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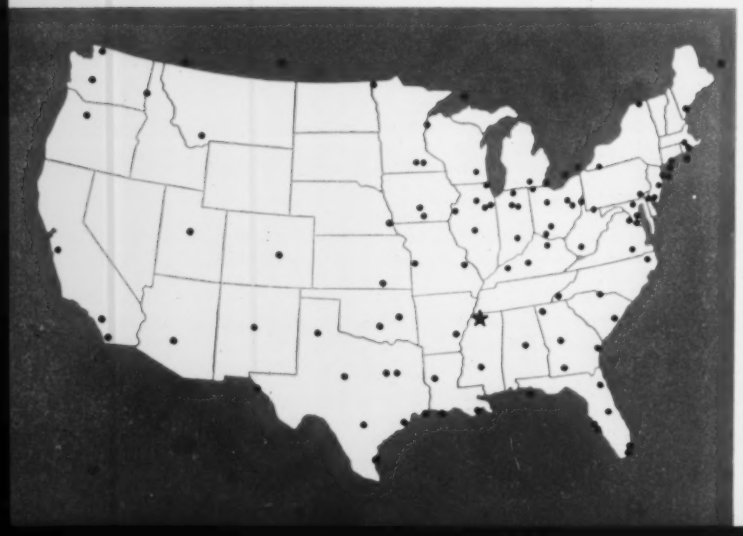

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John N. Beckley, vice-president and eastern district manager of the Austin company, with offices in New York and Roselle, N. J., has been elected to the board of directors of the international engineering and construction firm. Mr. Beckley joined the company as an estimator in 1941 and has been in charge of its eastern operations for the last five years.

Robert H. De Grange is now editor of the *Chicago Public Works Engineer,* the newsletter of the Chicago Department of Public Works. Recently, Mr. De Grange was appointed chairman of publicity, and editor of ASCE News by the Illinois Section. For "outstanding achievement in bringing about a better understanding of the American way of life" he has received two Freedoms Foundation awards.

W. R. Barrows has joined Gibbs & Hill, Inc., in New York City as chief hydraulic engineer. For the past three years he held a similar title with the Pioneer Service & Engineering Company, of Chicago, where he was a member of the staff for eight years. Mr. Barrows' career also includes eleven years as engineer for the Tennessee Valley Authority.

Richard Newell Coolidge, president of the Sewanee Silica Sand Company, Nashville, Tenn., and long associated with river and harbor enterprises, was honored recently by the Army with a Certificate of Appreciation for his foresight and vision in promoting full development of the water resources of the Cumberland River. His leadership and untiring work over a period of years were significant in the completion of the multi-million dollar projects now existing on the Cumberland and its tributaries.

Theron R. Dosch, of the U. S. Geological Survey, has been transferred to assistant district engineer of the Surface Water Branch, Madison, Wis., after a number of years as hydraulic engineer in California—most recently in the Menlo Park subdistrict office. In his new assignment he will assist in the direction of Wisconsin's state-wide program of water resources studies.

Ivan L. Tyler, formerly manager of the Field Research Section of the Portland Cement Association, has been appointed research counselor in the association's Research and Development Division. In his new job, Mr. Tyler's experience and training in concrete technology will be fully applied to advanced research and counseling.

Vernon J. Hansen has been named project manager of the Lahontan Basin project office of the U. S. Bureau of Reclamation in Carson City, Nev. With time out for active duty in the U. S. Army, Mr. Hansen has worked with the Bureau since 1938. His most recent assignment was to supervise the development field branch at Eureka, Calif., which is conducting a survey of economic resources and problems of northwest California as they relate to the land and water resources.

Raymond D. Mindlin, professor of civil engineering at Columbia University and member of the staff since 1932, recently received a "Great Teacher Award" from the Society of Older Graduates of Columbia University. The citation read in part "For your peacetime contribution to Columbia, and through Columbia to the nation, we present to you now our own accolade—the Great Teacher Award." Currently Dr. Mindlin is serving on the National Aeronautics and Space Administration's new Research Advisory Committee on Structural Dynamics.

E. M. Chafets has been appointed director of the Computer Time Sales Division of the Computer Usage Company, Inc., New York City, the largest independent firm of electronic data processing specialists in the U.S. Previously, he was senior civil engineer for Howard, Needles, Tammen & Bergendoff in New York.

C. H. Sandberg, formerly bridge engineer in the Chicago office of the Atchison, Topeka and Santa Fe Railway System, has been named chief engineer for the system's Eastern Lines at Topeka, Kans. **W. E. Robey,** assistant bridge engineer, succeeds Mr. Sandberg as bridge engineer in Chicago.

John A. Heinen has joined the technical service department of the Sika Chemical Corporation, Passaic, N. J., as an engineer. For the past twelve years he has worked in almost every phase of concrete production and construction, including two-and-a-half years as senior concrete engineer with Metcalf & Eddy on several large defense projects in Greenland.

Lewis A. Dickerson and **Edward D. Lewis** recently formed a new firm for the practice of civil engineering. The firm of Lewis-Dickerson Associates will maintain offices in Watertown and Massena, N. Y., and will continue, with the same staff, the practice formerly conducted by Sargent-Webster-Crenshaw & Folley in which Mr. Lewis and Mr. Dickerson were partners. Mr. Dickerson is the immediate past president of the Syracuse Section and is currently chairman of the District 3 Council.

Roy Aaron, for the past five years an associate consulting engineer with the Chamlin Engineering Service of Peru, Ill., has been appointed assistant to the managing director of the American Concrete Pipe Association, Chicago, Ill. He was formerly a project officer with the United States Army Corps of Engineers.

(*Continued on page 28*)

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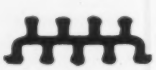

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FLEXSTRIP
Water Stops. For horizontal or vertical construction joints, especially under extreme conditions of separation. Variety of widths.

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Water Stops. For expansion joints where shearing stress is anticipated. Three rib style most popularly used.

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Send engineering data and literature on Water Seals water stops.

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Frederick R. Knoop, Jr., has returned to Whitman, Requardt and Associates, Baltimore, Md., after six years as vice-president of the contracting firm of Charles R. Scrivener Company, Inc. of Baltimore. Colonel Knoop's previous employment period with Whitman, Requardt and Associates was from 1946 to 1954.

K. L. Kollar recently returned to the United States after ten years as sanitary engineering consultant with the International Cooperation Administration in Mexico, Ecuador, and Venezuela. Since his return Mr. Kollar has become assistant to the director of the Water and Sewerage Industry and Utilities Division of the Department of Commerce, Washington.

William F. Holmes has left the Charlotte, N. C., office of S. H. Kress & Company, where he was regional architect to become building director in the firm's New York Office. Mr. Holmes has been with S. H. Kress & Company for more than twenty-five years.

Harry Richard Erps, regional bridge engineer with the U.S. Bureau of Public Roads, at Hagerstown, Md., retired recently after thirty years of service. In his capacity as bridge engineer, Mr. Erps has contributed to effective bridge planning and construction in the complex traffic areas of the District of Columbia, Virginia, West Virginia, Maryland, Delaware, Pennsylvania and Ohio.

Otto Hoefler on January 1 was named district manager at Portland, Ore., for the American Bitumuls & Asphalt Company, a division of Standard Oil Company of California. Formerly he was district manager for American Bitumuls, Oakland, in charge of sales in the northern California area.

Richard T. Richards has joined the New York City consulting engineering firm of Burns and Roe, Inc., as a supervising civil engineer. He was previously employed by Ebasco Services, Inc., as a civil engineer and, for three years, was an officer in the Civil Engineer Corps of the Navy.

Alfred C. Ingersoll, civil engineer, who has been on the faculty of the California Institute of Technology the past ten years, has been named dean of the School of Engineering at the University of Southern California. Last year Dean Ingersoll was chairman of the engineering education committee of the Los Angeles Section of ASCE which studied the professional growth of 607 young men in the area. In the summer of 1958 Dean Ingersoll conducted a special feasibility study for a high velocity air-to-water missile launching facility for the U. S. Naval Ordnance Test Station.

. . . . . *Am-Soc Briefs*

▶ ▶ Convention calendar. . . . The Reno Convention, to which the Sacramento Section and its Nevada Branch will be hosts this June, will incorporate technical sessions of the U. S. Committee on Large Dams, the Annual Conference of the Irrigation and Drainage Division, and the Thirteenth Annual Pacific Southwest Conference -- each one of them a drawing card in itself. The well known sightseeing and vacation attractions of the Reno area are discussed on page 38.

▶ ▶ The way to international understanding is through the "common language" of engineering and science. This was the substance of talk at a meeting of U. S. and Russian engineers, sponsored by ASCE on February 1 prior to the Russian delegation's takeoff on a twenty-day air tour of the U. S. . . . Late in August ASCE will take part in the plenary Conference of the Engineering Societies of Western Europe and the United States, to be held in Brussels. A comparative study of engineering education in twenty countries will be the objective of the conference. The study is being financed by a grant from the National Science Foundation and the Office of European Economic Cooperation.

▶ ▶ Every branch of the profession has a stake in the 1960 Nuclear Congress, which will feature the benefits to be derived from the atom. Three Environment Sessions will present thirteen papers of special value to civil engineers. This year ASCE is manager of the congress, which will be held in New York City's Coliseum, April 4-8.

▶ ▶ New ASCE Salary Index. . . . The Society's biennial Salary Index changes this month to provide figures as of January 30. It will be noted that the trend in pay rates for civil engineers is still slightly up. The report is based on analyses of data provided semiannually by a picked group of respondents (consulting firms and highway departments).

▶ ▶ Index to Civil Engineering. . . . Each member is entitled to a copy of the 1959 Index to Civil Engineering. A simple post card request to Society Headquarters will do the trick.

▶ ▶ Combined Index to ASCE Publications. . . . For complete coverage of the Society's 1959 year in print, there is now a Combined Index covering the Division Journals, Transactions, and Civil Engineering. Also included are reprints of the Proceedings Abstracts that are published each month in Civil Engineering. The price of the Combined Index is $2.00, with the usual 50 percent off to members. The coupon on page 142 will make ordering easy.

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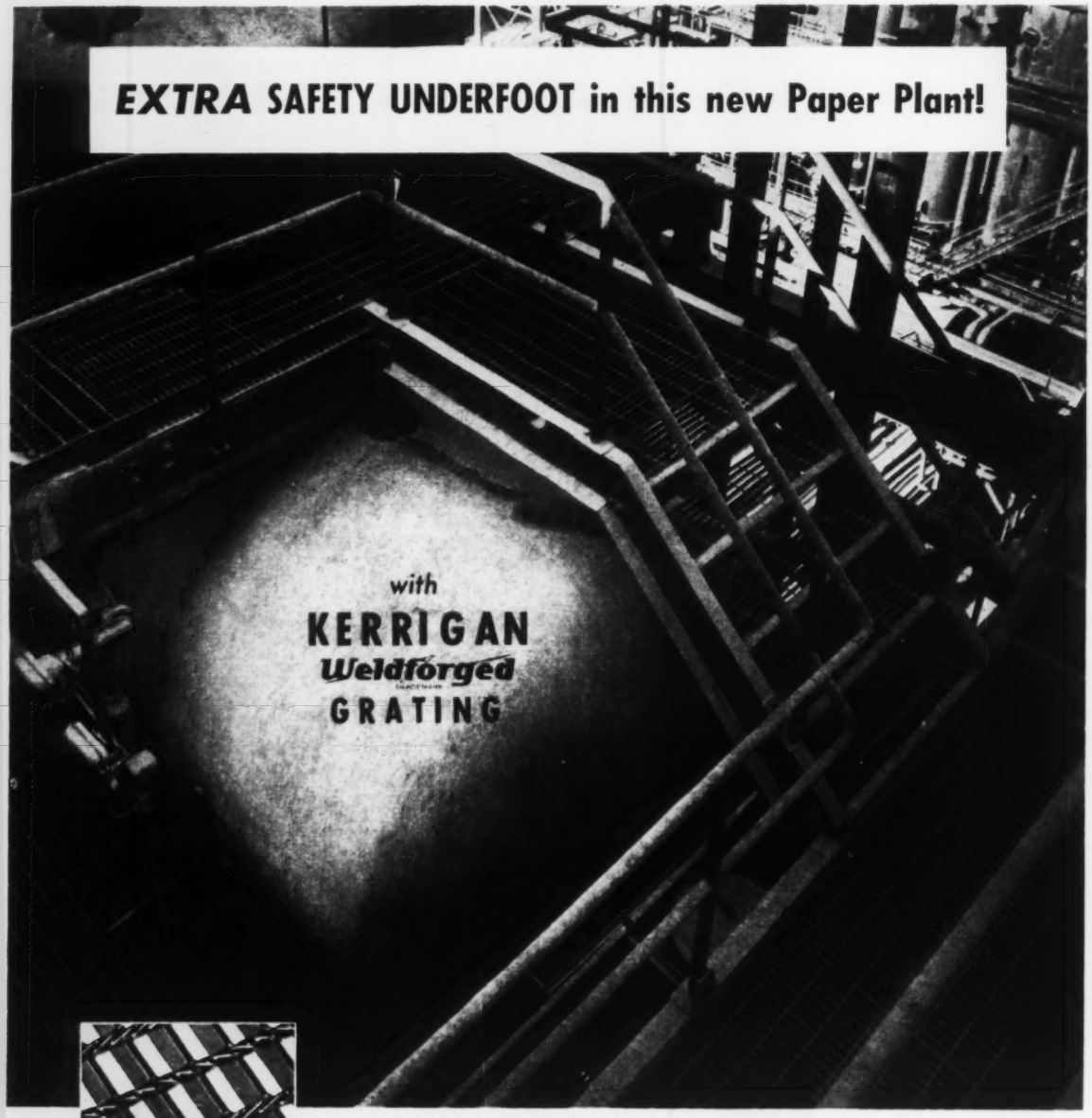

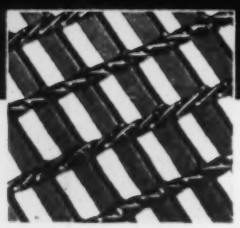

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When you specify Kerrigan Weldforged grating you get the utmost in underfoot and underwheel safety . . . in addition to its well known economy features. Bearing bars, and cross bars that alternate right and left, are electronically weld-forged into inseparable, one-piece units that stand up under the severest kind of punishment.

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Other KERRIGAN Products: GREULICH 4-Way Grid, Street & Highway Lighting Standards!

do you know that

The U.S. continues to up its spending for research and development? Results of a National Science Foundation survey for the 1953-1960 period indicate that research and development spending by the end of this period will be more like $12 billion than the originally estimated $5 billion. This increase is due primarily to a 160 percent rise in funds used for research and development by industry and private firms. However, more than half the funds expended by the industry sector are now coming from the Federal Government. The rate of research spending by government agencies, universities, and other nonprofit organizations is also increasing, though not as sharply as in the industrial sector. The full NSF report is for sale by the Superintendent of Documents at 10 cents a copy.

▪ ▪ ▪

Since World War II the share of intercity freight traffic has dropped from 67 to 45 percent? The drop in the rail share of commercial passenger traffic has been from 73 to 31 percent. In the process, 600,000 jobs have disappeared. The Association of American Railroads attributes the situation partly to "featherbedding."

▪ ▪ ▪

Australia has one of the world's largest continuous prestressed concrete bridges? Spanning the Narrows section of the Swan River in West Australia, the bridge carries six lanes of traffic and two 10-ft walkways. It is 1,100 ft long between abutments, and has spans of 160, 230, 320, 230, and 160 ft.

▪ ▪ ▪

Colored roads are a practical possibility? Color-coated, reflective roads, which perform a guidance function around the clock, were found to speed up traffic by increasing driver awareness of interchange ramps in a seven-week test conducted by the Minnesota Highway Department and the Minnesota Mining and Manufacturing Company. The test results were reported in two papers presented at the Highway Research Board's recent annual meeting in Washington.

▪ ▪ ▪

An engineering degree is no longer a passport to a good job? This is the opinion of the Office of Student Personnel of the Cornell University College of Engineering. Because of the intense competition for engineering graduates that developed a few years ago, many companies have been hiring liberal arts graduates and technicians to fill jobs previously held by engineers. Cornell also reports that its five-year curriculum is paying dividends to its graduates in the form of higher-than-average starting salaries.

▪ ▪ ▪

Nevada leads the country in the rate of population growth? Three states—Nevada, Florida, and Arizona—are leading in rate of population gain since the 1950 Census, the Department of Commerce says. However, California—the nation's second largest state, from a population standpoint—experienced the greatest numerical increase, 3,698,000, for a total of 14,284,000.

▪ ▪ ▪

Glen Canyon Reservoir will be named Lake Powell? The 186-mile-long reservoir, to be created on the Colorado River by the construction of Glen Canyon Dam, will honor John Wesley Powell. A noted geologist and explorer, Major Powell led expeditions down the Green and Colorado Rivers in 1868 and 1871—the first exploration and survey of the famous river system. The permanent town at the Glen Canyon Dam site has been named Page, in honor of the late John C. Page, Honorary Member of ASCE and Commissioner of Reclamation.

▪ ▪ ▪

There is a new truck that floats as well as rolls? The 2½-ton vehicle, now in production by the Chrysler Corporation, can float with a 5,000-lb payload, because of its hull-type aluminum body. The body is of unitized construction, with the hull shape protecting the engine, axles, and other operating parts from weather and dirt. There are three models, with four-wheel, six-wheel, and eight-wheel drive. The versatile vehicle is described in a recent issue of the "Aluminum News."

▪ ▪ ▪

January was the first month in which steel production crossed the 12-million-ton mark? According to the American Iron and Steel Institute, the January output of 12,043,000 net tons of ingots and steel for castings utilized 95.4 percent of the nation's steelmaking capacity. The previous record for a month was set in December 1959, with 11,989,319 tons. The year-ago January production was 9,317,385 tons.

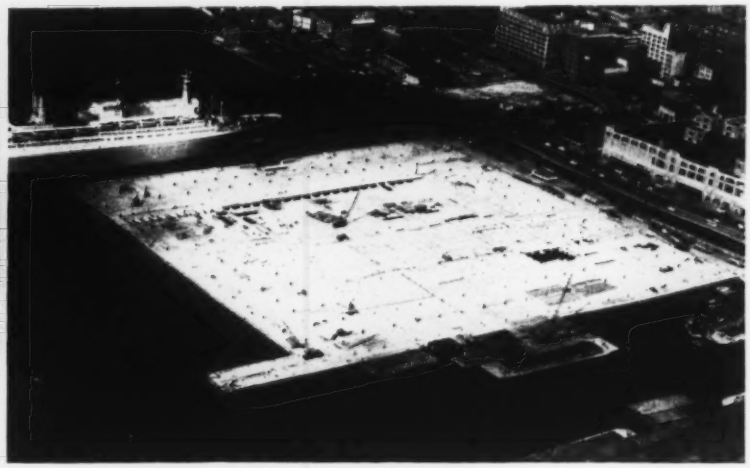
▪ ▪ ▪

A $17 million vehicular tube under San Francisco Bay will soon connect Oakland and Alameda? The project will eliminate a serious traffic bottleneck in the single existing tunnel between the two cities. The interesting "why and how" story of the tube will be told in the April issue.

6,021 Prestressed Slabs

for 15-Acre Deck of Holland-America Pier

Trucks delivered four slabs at a time to be placed by crane. Typical slab weighed 7½ tons, measured 5' x 20' x 12". Joints, filled with 3,750-psi 'Incor' concrete, were ridden by loaded trucks in two days.



(Left) Casting P/S slabs in severe weather. Concrete was 65° at placement; 80° heat was gradually applied with live steam for 4 hours, then 140° heat for 8 hours, diminishing during a 3-hour cooling period. (Right) Cutting the prestressing strands.

● Prestressed concrete slabs were used for the deck of Pier 40 in New York, to accommodate extremely heavy ultimate loads on a deck of minimum thickness (12") resting on widely-spaced stringers (20' apart). Design loads ran as high as 600 pounds per square foot in the cargo storage area. A total of 6,021 prestressed slabs was required for the 15-acre deck.

SUBSTRUCTURE FOR PIER 40
(HOLLAND-AMERICA LINE)
Foot of West Houston Street, New York, N. Y.

Owner: **CITY OF NEW YORK**
Department of Marine & Aviation

Architects and Engineers:
ROBERTS & SCHAEFER CO., INC.

General Contractor: **STOCK CONSTRUCTION CORP.**

Slab Fabrication and Placement (joint venture):
CORBETTA CONSTRUCTION CO., INC.
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(All of New York, N. Y.)

An average production rate of 48 slabs per day was maintained at the casting yard during an extremely cold winter, using dependable 'Incor'® cement in an 8-bag, steam-cured, 5,000-psi concrete, with stress release strength specified at 3,500-psi. 285 special 6,000-psi slabs were released at 4,650-psi. Release strengths were generally attained in 15 hours, permitting the high production rate.

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An implied contract—professional status

Professional status is therefore an implied contract: to serve society over and beyond all specific duty to client or employer in consideration of the privileges and protection society extends to a profession.

N. W. DOUGHERTY, HON. M. ASCE

Dean Emeritus, College of Engineering

University of Tennessee, Knoxville

These words of the late Prof. W. E. Wickenden, in a *Guide for Junior Engineers*, point to wide areas of professional responsibility. The engineer cannot be lost in the crowd; he cannot hide behind his employer; he dare not let others take responsibility for his works.

The Canons of Ethics of the Engineers Council for Professional Development contain the following statements about the professional engineer:

■ **He will extend** a general understanding of engineering to the public.

Because of lack of knowledge, the public often misunderstands the works of the engineer and surrounds them with mystery as if they were occult. The profession will be served if the works of the engineer are better understood and his methods appreciated.

■ **He will discourage** the spreading of untrue, unfair, and exaggerated statements about engineering.

A whispering campaign, if not blocked by strong measures, will undermine almost any kind of activity. This and the "big lie" have been very effective methods of bringing suspicion on the democratic process. The Canons put engineers on guard against such methods.

■ **He is the guardian** of public health and public safety.

A professional is actuated by a service motive and works in a relation of confidence. These place upon him certain obligations since a registrant is given special privileges under the police power of the state.

■ **He will only express** opinions when they are founded on adequate knowledge.

Whenever there is engineering work there is gossip and rumor. Strange stories grow as they pass from mouth to mouth. It is the public duty of the engineer to puncture such imaginative balloons rather than to further their flight. Ordinarily, facts are easily obtained; these should be the bulwark of the engineer. Specialists in any field of endeavor have a duty to help their neighbors understand the impact of their specialty on the lives of all. They owe it to their specialty to combat misinformation and above all, since they know what is true, they must not be guilty of fostering an untruth.

■ **His expressions of convictions** must be based on honesty and integrity.

If professionals have a common foundation it is education, honesty, and integrity. The engineer is usually so solidly grounded in honesty that he avoids compromise, but in public relations much opinion is mixed with emotion and there compromise may be essential.

■ **If, because of his convictions,** he is employed to be partisan, he must make it clear whose interests he represents.

Under many circumstances the engineer is the umpire, or the disinterested third party. Here he must follow his convictions, but not as a partisan. However, there are cases when an engineer may sponsor a cause because of his convictions, but in such cases he will do well to make it clear whose side he represents. One cannot but feel a letdown when a nationally known news announcer begins a squib on the virtues of cigarettes or patent medicines.

■ **His public expressions** on engineering must be according to the best known facts.

He cannot tell half the truth to aid in a political campaign, or suppress part of his information to influence members of a legislature, or to sell a product.

(From Dean Dougherty's address, "Responsibilities of the Engineer to the Public," presented before the All Engineers' Luncheon at ASCE's Washington, D. C., Annual Convention.)

COMPOSITE CONSTRUCTION

in precast and cast-in-place concrete

ARTHUR R. ANDERSON, F. ASCE, Anderson, Birkeland & Anderson, Structural Consultants, Tacoma, Wash.

In recent years there have been remarkable developments in the production of structural members of high-strength precast and prestressed concrete. To exploit the possibilities of this new material of construction, the structural designer faces a challenge. Improved production techniques now make available precast concrete with a compressive strength of 7,500 psi or more. The designer, yet unguided by codes and textbooks, must resort to imagination and ingenuity in order to capitalize on the potential of this material in creating economical structures marked by elegance, durability, and architectural beauty.

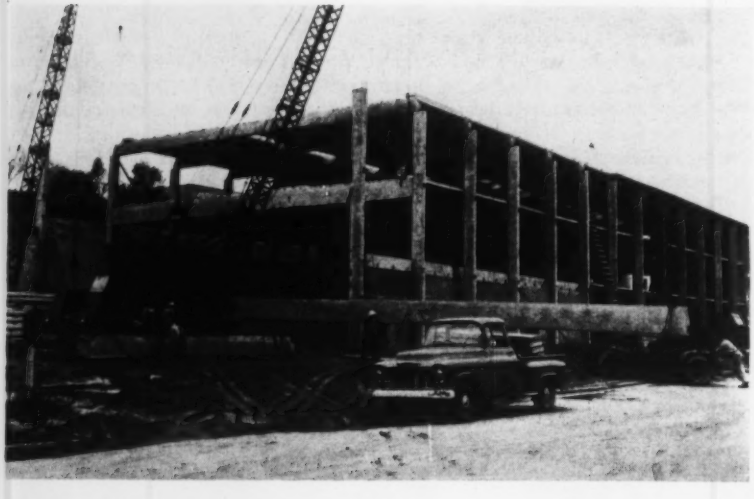
Composite concrete structures should combine the economy and efficiency of mass-produced, high-strength elements with the advantages of continuous monolithic structures hitherto cast in place at the job site. Construction trends now clearly indicate increased use of prefabricated units in all materials of construction. Designers are under pressure to keep the cost of structures within reach of the client's budget. As material and labor costs creep upward, new concepts of construction must be developed.

As in all types of manufacturing, economy in concrete construction can be achieved through mass production of standardized units. Thus the designer is called upon to create the standard units, and to make repetitive use of them. If the units can be assembled efficiently into the completed structure so as to become an integral part of it architecturally, maximum economy is achieved. With proper teamwork between the engineer and the architect, the structural and the architectural aspects will combine to produce a unified effect.

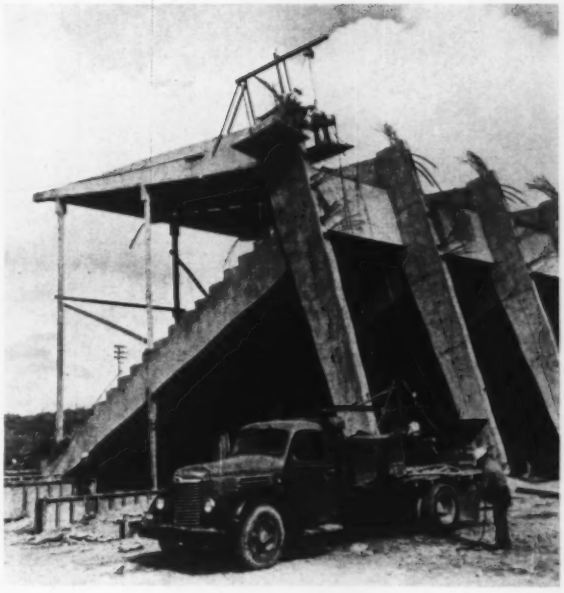
Transportation and erection of precast members involve a study of handling methods, allowable weights and dimensions, provisions for structural security during assembly, and suitable connections between members. When the design procedure for conventional cast-in-place concrete is compared with that for precast composite concrete, it is obvious that the latter is more demanding. The structural engineer not only must analyze the structure as finally built, but also must consider what happens to the individual members during several stages of construction.

Until design criteria for precast-composite concrete connections are established, it may be necessary for the structural engineer to prepare prototypes of the connections and subject them to load tests. Although many of the tests may be relatively simple, the results obtained can contribute substantial savings in the cost of the structure.

One of the most obvious tension connections between precast concrete members is made by the welding of projecting reinforcing bars. If the connections are designed in this manner, high-carbon hard-grade bars should be avoided. Intermediate-grade reinforcing steel (carbon content, 0.30 to 0.60 percent) can be welded. Low-hydrogen electrodes, AWS class E7015 or E7016, should be used. Preheating and controlled cooling are important, particularly in cold weather. Tests carried out



Aquinas Academy in Tacoma, Wash., is a completely precast and prestressed concrete building, 70 by 240 ft, built in five months. The second story of this three-story building was omitted at one end to provide height for the gymnasium. The 70-ft beams over this area were post-tensioned through the columns as shown in Fig. 12. The precast walls were joined to the columns as shown in Fig. 9. The floor and roof slabs were precast channel sections, with the negative bars projecting from the ends welded to provide continuity over the beams.



Precast concrete stadium in Sumner, Wash., is 180 ft long and has a 45-ft cantilevered roof. The three elements comprising the frame were joined by post-tensioning, here illustrated. Precast concrete wall panels 4 in. thick and 8 ft high were fitted between the columns. The column and wall assembly was compressed into a monolithic unit by post-tensioned longitudinal tendons running continuously from end to end of the structure. Pretensioned L-shaped slabs with a curtain of welded wire fabric projecting from all edges were connected in the structure with cast-in-place concrete joints. The roof panels, pretensioned channel slabs 4 ft wide, were supported on a flange of the roof beam. Steel projecting from the ends of the slabs was welded to bars run through sleeves in the beams, and the space between slabs and beams were filled with concrete.

on welded joints made with reinforcing bars of intermediate grade indicate that, when the joints are properly made, the tensile yield strength of the bars can be developed without difficulty.

Three types of welded connections used for intermediate-grade reinforcing bars in sizes No. 3 through No. 9 are shown in Fig. 1. Connections Type II and Type III were made by welding the bars with a short lap. Because of eccentricity, the failure load was hastened by rotation of the joint. When embedded in concrete with adequate lateral support, these connections obviously have a better performance. The Type I connection utilizes a short angle bar. This concentric arrangement, although it requires more material, may be preferred in certain situations.

Another form of tension connection is made by projecting the reinforcing bar of one member into a sleeve embedded in the adjacent member; at the time of erection this sleeve is filled with a thick neat cement-paste grout. To develop a good bond between the sleeve and the contiguous concrete and grout, the use of spiral flexible metal tube is recommended. Pull-out tests on this type of connection (Fig. 2) show that the ultimate tensile strength of the bar can be developed in less than 14 bar diameters.

A very satisfactory shear connection can be obtained by casting fresh concrete against previously hardened concrete whose surface is roughened with undulations about ¼ in. deep. When the roughened surface of the hard concrete is coated with a neat cement slurry immediately ahead of the casting of the fresh concrete, an excellent bond results. Tests show that the ultimate concrete shear strengh of the interface varies from 700 psi to 1,500 psi, for reinforcing steel ratios of 0.001 to 0.025 respectively, projecting through the joint. From the test data, it is evident that shear keys in concrete are redundant when the interface surface is cast rough.

Compression connections between

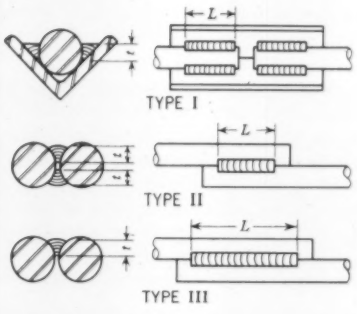


FIG. 1. Tests were conducted on three types of welded connections used for intermediate-grade reinforcing bars. The tests indicated that, for properly made welds, the tensile yield strength of the bars can be developed without difficulty.

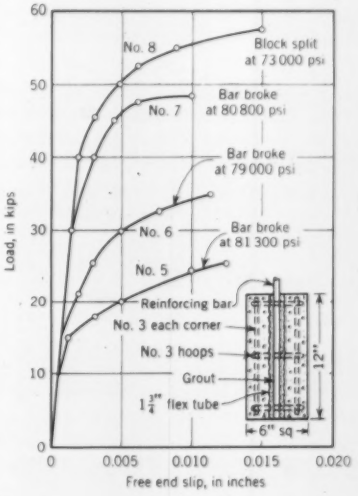
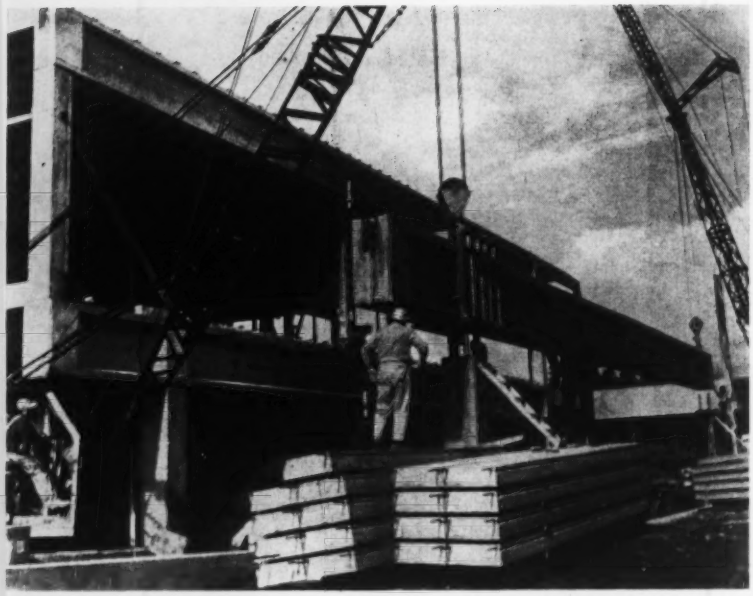
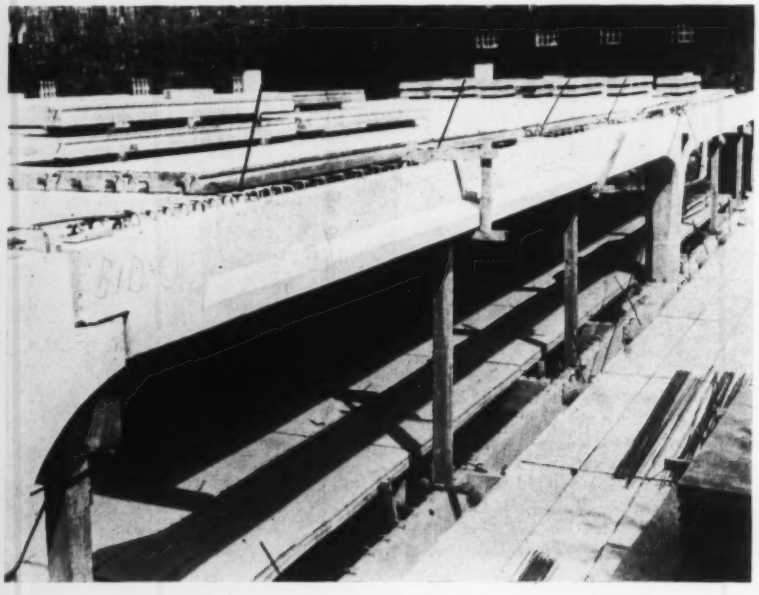


FIG. 2. A form of tension connection is made by projecting the reinforcing bar of one member into a sleeve embedded in the adjacent member. Results of pull-out tests of this type of connection are shown in curves. Bar sizes Nos. 5, 6, and 7 fully developed the tensile strength and broke outside the concrete block. The block containing the No. 8 bar split vertically on all four sides when the steel tension reached 73,000 psi.



Florida Building in Washington, D. C., has 90-ft prestressed concrete beams and the second floor is cantilevered 10 ft at one end. Here a beam is being erected on a precast column, whose reinforcing bars are threaded into sleeves in the beam. The precast channel slabs for the second floor, in foreground, have negative reinforcing bars projecting from their ends. When these bars are welded together, the space between the ends of the slabs is filled with concrete to develop continuity and composite action with the beams.

Three-level parking garage in Olympia, Wash., is 120 by 240 ft with seven interior columns. Each frame is a two-story, two-span bent made up of two exterior double L-shaped columns, one interior double T-shaped column, and four girders of inverted T-section. The flange of the prestressed girder supports prestressed beams on which precast channel slabs are placed. A space over the girders was provided for a cast-in-place concrete slab designed to function as a composite flange. Reinforcing bars placed in this space developed negative moments at the ends of the beams and girders, as indicated in Fig. 16.



precast members can be made by filling the joint with concrete or grout. Shrinkage can be avoided by dry-packing or using an expanding admixture such as aluminum powder or Embeco aggregate. Where high concentrations of bearing stress occur near edges, the concrete should be confined by encasing the end of the member in steel to avoid the danger of spalling. The efficacy of such confinement is illustrated by the test data given in Fig. 3, in which concentrated bearing stresses near the edge of a section exceeded 40,000 psi.

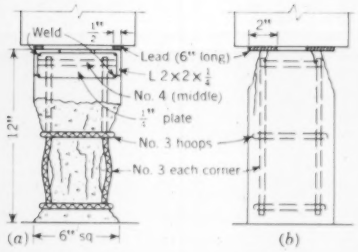


FIG. 3. Reinforced concrete compression specimens were tested with loads placed at upper edges. Concrete compression strength at time of test was 7,000 psi. When confined by a steel cap (Fig. 3 a), the specimen sustained a concentrated compression stress of 43,700 psi at the top edges. Without the steel cap (Fig. 3 b), the concrete failed at the upper corners at 2,080 psi.

Joint details most often encountered in precast composite concrete construction may be grouped in the following categories: (1) column to footing, (2) wall to column, (3) beam to column, and (4) beam to slab.

In practice the number of methods that can be used to join members together is almost without limit. Some types of joints or connections that have been determined to be satisfactory by test and experience are shown in Figs. 4 through 16 (opposite page).

The writer wants to express his appreciation to the architects and builders that have collaborated on the projects described.

The writer is indebted to his partners, Halvard W. Birkeland, F. ASCE, and Thomas W. Anderson, M. ASCE, for their many valuable suggestions and to Robert W. Mast and other members of the staff for their assistance in the preparation of this article.

(This article was originally presented by Mr. Anderson as a paper at the ASCE Annual Convention in Washington, D. C., before the Structural Division session on Composite Design in Building Construction, presided over by R. A. Hechtman, chairman of the Division's Committee on Session Programs.)

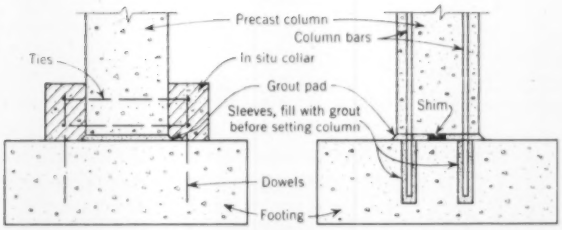


FIG. 4 (Left). Precast column stands on a footing with an accurately placed grout pad. Grout pad is allowed to harden before column is set. Base of column is cast square and flat. In situ collar, of cast-in-place concrete, is placed after column has been erected and braced.

FIG. 5 (Right). Precast column stands on a footing in which grouting is done at time of erection. Base of column need not be as accurately cast as that of column in Fig. 4, but more time may be required in setting it to accurate line and elevation.

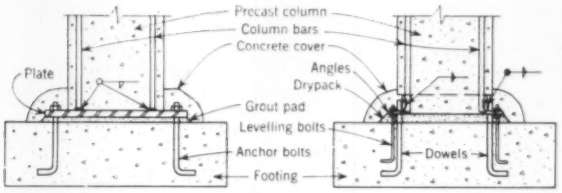


FIG. 6 (Left). Precast column is set on a steel-plate base. Leveling nuts may be placed under the plate for convenience in erection.

FIG. 7 (Right). Precast column is set with an angle-bar collar at the base. Column bars are welded to the angle and, after erection, footing dowels are welded to the opposite side of the angle. This connection is advantageous where a joint with high moment resistance is required.

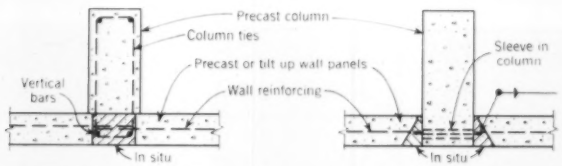
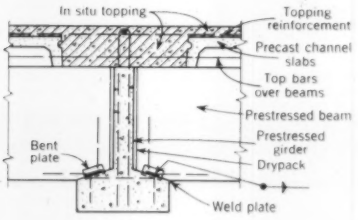


FIG. 8 (Left). Precast column is connected to two precast wall panels. In this case, the finished column projects on the outside of the structure, so that the inside wall surface is flat. Column hoops and wall bars are welded together, and space between the three precast elements is filled with in situ concrete (hatched area).

FIG. 9 (Right) Precast column with horizontal sleeves makes it possible to weld a short bar to the reinforcing bar in the wall panel on each side. Space between precast wall panel and column is filled with grout after welding.



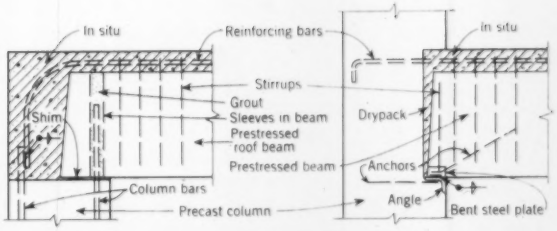


FIG. 10 (Left). Precast roof beam is connected to a column. Interior column bars project upward into sleeves of beam, and space is filled with grout. Bent reinforcing bars placed over the beam are welded to exterior column bars. Space over beam and column is filled with in situ concrete.

FIG. 11 (Right). Precast floor beam is connected to a column. Steel embedded in column and beam were welded together after erection. Bar from column extending over beam is encased by in situ concrete, and may develop frame action.

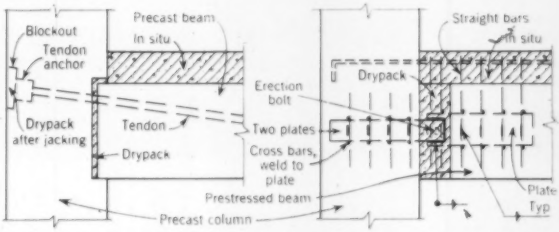


FIG. 12 (Left). Precast beam is connected to a column by post-tensioning. Space at end of beam is filled with dry pack before the tendon is stressed.

FIG. 13 (Right). Precast beam is connected to a column by an erection bolt before welding. This type of connection is advantageous in multi-story construction as it speeds erection. Space around the welded connection is reinforced with suitable hoops and filled with dry-pack or cast concrete. Frame action may be developed by extending the bar from the column over the beam and covering it with in situ concrete.

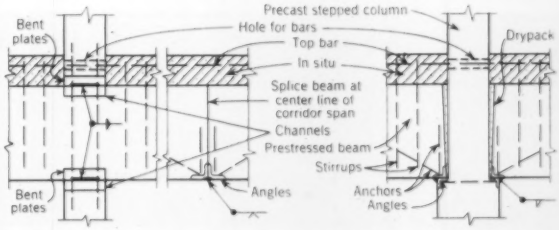


FIG. 14 (Left). Precast beam is connected to an interior precast column. This detail is applicable to multi-story construction where beams are continuous over columns. Steel embedded in column is joined to that embedded in beam by welding. Negative reinforcing bars may be run through sleeve in column and covered with in situ concrete.

FIG. 15 (Right). Precast beam is connected to an interior precast column. Column is stepped to provide beam seat. Steel embedded in column and in beam, designed to confine concrete, are joined by welding. Negative reinforcing bars may be run through sleeve in column and covered with concrete.

FIG. 16. Precast girder, beam, and channel slab are made composite with in situ concrete. Bottom flange of inverted T-girder serves as seat for beams. Embedded steel in girder and beam are joined by welding. Precast slab over the girder may be omitted, permitting a substantial in situ section to be cast as a composite top flange for girder and to provide space for placing negative reinforcing bars over beams and girders.

ASCE NEWS

Sacramento and Reno Groups Plan ASCE Convention

Next on the ASCE Convention calendar will be the Reno Convention, set for June 20-24, with the Sacramento Section and its Nevada Branch as joint hosts. The co-chairmen are Dean Howard B. Blodgett, of Reno, and former ASCE Director R. Robinson Rowe, of Sacramento. The State Office Building has been designated official Convention headquarters, and there are three "official" hotels—the Mapes, the Riverside, and the Holiday. Information about registering and more data on hotels will be provided in the Convention program, to be published in the May issue.

A few features already planned are (1) joint technical sessions of four Divisions with USCOLD (the United States Committee on Large Dams); (2) the Annual Conference of the Irrigation and Drainage Division, joining with the Sanitary Engineering Division on the theme of Desalinization of Water Supplies; (3) Highway and Construction Division sessions and a field trip on mountain and desert sections of the Interstate Highway System; (4) a Structural Division Symposium series on Seismic Design Codes; (5) a University of Nevada Alumni Dinner, and (6) the thirteenth Annual Pacific Southwest Conference.

Many attending the Reno Convention will combine business with pleasure. Foreseeing just that, local hosts timed the Convention for the first week after school so that members can bring their families to enjoy the high Sierras and Lake Tahoe at their best. The Lake, Squaw Valley of Winter Olympics fame, many Sierra resorts, and the colorful ghost-mining-town, Virginia City, are all within 50 miles of Reno by excellent highways.

Some are already planning to route their trip to Reno via Glen Canyon Dam, the Kaibab, Bryce and Zion Canyons. Others will drive farther west, crossing Hoover Dam to visit Las Vegas and Tonopah. One engineer from Texas writes that he will go on after the Convention to spend a few days in Yosemite, which is on the fascinating Los Angeles-to-Reno road. Wise travelers will lay their plans early and make reservations, for the choicest spots are in great demand.

Reno alone will be well worth the trip to the Convention. The climate is perfect in June, and the days will be 16 hours long. The Truckee River will be swollen with snow melt, the Truckee Meadows at their greenest, and Reno always the "biggest little city in the world."

Undaunted by 30-ft drifts on historic Donner Pass between them, Convention co-hosts—the Sacramento Section and its Nevada Branch—maintain constant communication to assure the best-ever Convention. In view at left General Chairman Howard B. Blodgett is seen at phone in Reno, relaying question raised by (left to right) J. Webster Brown (Hotel Committee), Carlo Panicari (Entertainment Committee), Prof. John A. Bonell, Jr. (General Committee), and Vernon M. Meiser (president, Nevada Branch). Answering the question in Sacramento (right-hand photo) are Co-chairman R. Robinson Rowe (at phone), assisted by (left to right) Henderson E. McGee (Attendance Promotion Committee), Clair A. Hill (president, Sacramento Section), Francis N. Hveem (General Committee), and Francis G. Christian (chairman, Pacific Southwest Council).

Nuclear Congress to Feature Benefits from Atom

Every branch of the engineering profession has a stake in the 1960 Nuclear Congress, which has for its theme the application of nuclear energy for mankind's benefit. This year ASCE is manager of the congress, which will be held in New York City's Coliseum, April 4-8. As congress sponsor, Engineers Joint Council is coordinating the programs of the 28 participating societies.

Sixty papers, covering seven major areas of interest in the atomic field, have been prepared for the technical program. All the papers have been specially selected to deal with nuclear production problems, which the program committee, headed by E. B. Gunyou, felt needed more study and clarification. Considerable attention is being paid to the reactor problem, with 21 papers dealing with some aspect of the subject.

Three Environment Sessions

The program for the three sessions on environment problems, which will be of special interest to civil engineers, is now ready. In the field of plant construction and site location—set for Monday afternoon, April 4—there will be five papers, presented under the chairmanship of J. Cal Callahan, F. ASCE, of Morris Knowles, Inc.:

1. Results of 1959 Nuclear Power Plant Containment Tests, Alf Kolflat, Sargent and Lundy.
2. Review of Shippingport Operations—Site Factors, John E. Gray, Coordinator of Atomic Power, Duquesne Light Co.
3. A Progress Report on the *N. S. Savannah*, P. P. Eddy, K. W. Hess, Nuclear Projects Office, GAO.
4. Civil Engineering Aspects of Nuclear Power Plants, R. W. Kupp, J. C. Tourek, Vitro Engineering Co.
5. Sites for Nuclear Power Plants for Large Spanish Utility, Jamie MacVeigh, president, Tecnatom.

In a second environment session—scheduled for Tuesday afternoon, April 5, and dealing with regulations protecting public health—there will be four papers:

1. Status of Regulation at the Municipal Level, Hanson Blatz, New York City Health Department.
2. Status of Regulation at the State Level, Oliver Townsend, New York State Office of Atomic Development.
3. Status of Regulation at Federal Level: Responsibilities of the U. S. Public Health Service, Francis J. Weber, Chief, Division of Radiological Health, Department of Health, Education and Welfare.
4. Current Status of International Regulatory Activities in the Field of Public Health, A. I. Galagan, International Atomic Energy Administration, United Nations.

This session will be under the chairmanship of Merrill Eisenbud, New York University.

A third environment session, concerned with water supply and waste disposal, is planned for Tuesday afternoon, April 5, under the chairmanship of E. Shaw Cole, F. ASCE, the Pitometer Associates. There will be four papers:

1. A two-year Study of Environmental Radioactivity Levels Prior to Nuclear Power Plant Operation, John V. Nehemias, Director of Radiological Health Surveys of the National Sanitation Foundation, University of Michigan.
2. Strontium 90 in Surface Water, C. P. Straub, L. R. Setter, P. F. Hallbach, A. S. Goldin, Department of Health, Education and Welfare, Robert A. Taft Sanitary Engineering Center.
3. Continuous Calcination of Aqueous Radioactive Waste Solutions by Radiant Heat Spray, R. T. Allemann, P. M. Johnson, General Electric.
4. Radioisotopes in a Municipal Water System near the Hanford Atomic Products Operation, Robert L. Junkins, General Electric.

As in the past, the International Atomic Exposition will be held in conjunction with the congress. Also coordinated with the congress program will be sessions of the Society of Automotive Engineers on nuclear propulsion in aircraft. The latter group will hold its sessions at the Hotel Commodore during congress week.

The 1960 Congress will be able to report remarkable progress in the nuclear industry. In the United States now, according to the Atomic Industrial Forum, Inc., there are eight nuclear power projects in operation, ten others under construction, eight in preliminary construction phases, and five more for which plans have been announced—a total of 31 projects. In addition, there are eight U. S. power reactor projects abroad.

International Atomic Exposition

The Atomic Exposition will be set up on the second floor of the Coliseum. It will be open from 11:00 a.m. to 5:00 p.m. on Monday, and from 9:00 a.m. to 5:00 p.m., Tuesday through Thursday. Well over 115 groups, including exhibitors from Canada and France, have reserved space for the exhibition. The display will cover the fields of designers, builders, manufacturers, components, and services.

All Congress Banquet

The major social gathering of the congress will be a general banquet and reception, to be held in the Grand Ballroom of the Statler Hilton, Wednesday night, at 7:00 p.m. This affair will be preceded by a cocktail hour and general get-together.

U.S. Papers Chosen for World Power Conference

Thirteen technical papers on methods of solving power-shortage problems are being submitted by United States engineers for the thirteenth biennial sectional meeting of the World Power Conference, to be held in Madrid, Spain, June 5-9. Under the general theme, "Methods of Solving Power Shortage Problems," the Madrid conference will stress long-term rather than short-term energy needs.

The papers representing the United States were selected at a meeting of the U. S. National Committee held in Washington on January 19. Civil engineers will be especially interested in a paper, entitled "Passamaquoddy—Harnessing Tidal Power for Energy," by J. W. Leslie, chief of the Engineering Division, New England Division, Corps of Engineers. Philip Sporn, F. ASCE, is another contributor of special interest to civil engineers.

The U. S. National Committee is one of 55 similar national groups from all over the world that make up the membership of the World Power Conference. ASCE is one of the professional engineering societies represented on the U. S. National Committee, which also includes representatives of industrial and utility associations and government agencies. New officers, elected by the U. S. National Committee for the coming year, are Francis L. Adams, chairman; James N. Landis, vice-chairman; and Brig. Gen. Stewart E. Reimel, U. S. Army (retired), secretary.

Further information about the conference may be obtained from Francis L. Adams, Chief, Bureau of Power, Federal Power Commission, Washington, D. C., or from Brig. Gen. Stewart E. Reimel, World Power Conference, 29 West 39th Street, New York 18.

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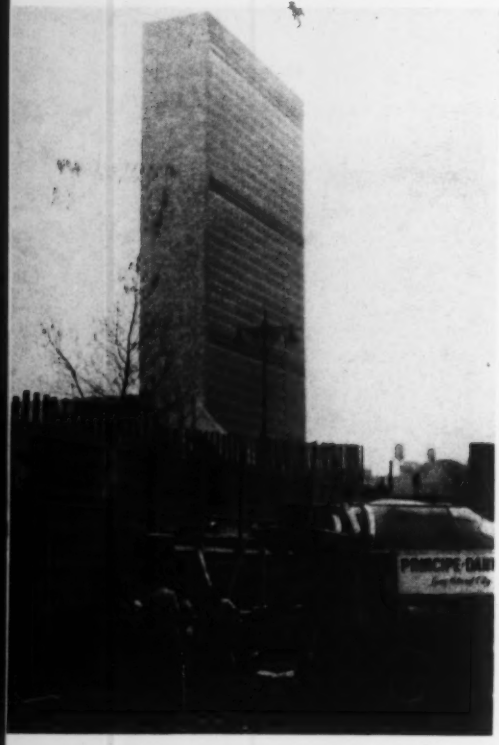
Prof. Ernest L. Spencer (left), chairman of the Massachusetts Section's UEC Fund Campaign, looks on as James Collins, president of the Northeastern University Student Chapter, presents check to ASCE President Frank A. Marston. Chapter Treasurer Paul S. Casey is at right. The Northeastern and University of Massachusetts Chapters are helping the Section approach its quota.

Construction of foundations for new UEC is underway on United Nations Plaza. Here wire reinforcing is being placed in the concrete. The Thomas Crimmins Contracting Company is building the foundations to Seelye, Stevenson, Value & Knecht design. The U.N. building looms in the background.



The number of Sections that have reached their quotas in the drive for funds for the United Engineering Center is over 30—Illinois recently became No. 31 on the list, Nebraska 32, and Iowa 33. Eighteen other Sections are over 70 percent and well within reach of the Honor Roll.

Executive Secretary Wisely has suggested a drive for $30 pledges—first for those who have not pledged and then as an additional pledge from those who have contributed but can help further to put the fund drive over the top. Thirty $30 pledges would put ten additional Sections into "The Champ" class. Twice thirty such pledges would round out another ten Sections. For all but a few Sections thirty determined solicitors contacting five ASCE members and getting $30 from each would finish up the established quota.

Then CIVIL ENGINEERING can end the UEC campaign with the printer's traditional closing symbol —30—.

The Board of Directors of the Los Angeles Section has approved the do-

UEC HONOR ROLL

Once again CIVIL ENGINEERING takes pride in listing the Sections that have gone over the top in the drive for funds for the UEC. The current Honor Roll carries 33 Sections, listed in the order of meeting their quotas. Thirty other Sections are within a few dollars of their goals.

Kentucky (123)
Lehigh Valley (137)
Nashville (103)
Cincinnati (141)
Columbia (132)
Philadelphia (152)
Hawaii (127)
Rochester (123)
Ithaca (142)
Southern Idaho (187)
Indiana (139)
Delaware (108)
Kansas City (115)
Central Pennsylvania (109)
Arizona (109)
West Virginia (141)
Central Ohio (106)
Tri-City (113)
Puerto Rico (115)
Wisconsin (106)
Georgia (109)
Maryland (107)
Tennessee Valley (106)
Metropolitan (113)
Connecticut (107)
Maine (102)
Rhode Island (100)
Alaska (102)
Central Illinois (106)
Syracuse (103)
Illinois (102)
Nebraska (104)
Iowa (103)

CAN BE MAGIC

nation of $1,000 from accumulated funds to the UEC drive. A gift of $150 has also been received from the New Hampshire Section.

Since the outset of the fund-raising campaign over two years ago, the Society's Student Chapters have shown their awareness of the importance of the Center as a symbol of the profession they are planning to enter by contributing of their limited funds to the drive. The most recent contributor is the Virginia Polytechnic Institute Chapter. Many Chapters make their gifts for the UEC to their Sections. There has been no organized campaign in the Chapters.

Similarly, though gift giving abroad has been on an informal basis, engineers all over the world have expressed interest in the campaign. Australia, Holland, Spain, Switzerland, Germany, the Philippines, the Belgian Congo, the Netherlands Antilles, and Canada are among the countries from which contributions have been received.

The benefits, tangible and intangible, of the new United Engineering Center have been well put into words by W. W. Moore, F. ASCE, who while serving as president of the San Francisco Section in 1958, wrote in the Section's monthly publication, *The Civil Engineer*, ". . . The location [of the Center], facing the United Nations headquarters, will emphasize the importance of engineering and the basic necessity of engineering services in all efforts to improve the lives of the people of the world. The public relations value will not be confined to the construction and opening of this fine facility—desirable public relations activities will continue for years. These activities will be facilitated and made more effective by the existence of a center from which professional activities will be coordinated.

"The construction of the United Engineering Center will be a great step toward unity within the engineering profession. . . . It seems evident that centralizing the headquarters offices of the major Engineering Societies will result in better interchange of ideas, coordination of policies and programs, and ultimately will be a large factor in bringing about effective unity within the profession. These factors will have direct bearing on the professional standing, popular recognition, and financial rewards of the engineering profession, and of engineers as individual members of the profession.

"As with all similar activities, those who expect immediate, tangible results for their investment in this project will be disappointed. However, those who feel that the profession has offered them a stimulating and rewarding opportunity to make a living for themselves and their families, while contributing to the welfare of their fellow men, will feel that this further enhancement of their profession in the interests of those who will follow in future years is an obligation which they will wish to accept enthusiastically. . . ."

(More ASCE News on page 62)

Campaign in ASCE Sections

Local Section	Quota %	Local Section	Quota %
The Champs!			
Southern Idaho	187	Georgia	109
Philadelphia	152	Delaware	108
Ithaca	142	Connecticut	107
Cincinnati	141	Maryland	107
West Virginia	141	Central Illinois	106
Indiana	139	Central Ohio	106
Lehigh Valley	137	Tenn. Valley	106
Columbia	132	Wisconsin	106
Hawaii	127	Nebraska	104
Kentucky	123	Iowa	103
Rochester	123	Nashville	103
Kansas City	115	Syracuse	103
Puerto Rico	115	Alaska	102
Metropolitan	113	Illinois	102
Tri-City	113	Maine	102
Arizona	109	Rhode Island	100
Central Pa.	109		
Down the Stretch			
Virginia	98	Sacramento	78
San Francisco	98	Cleveland	77
Massachusetts	94	Pittsburgh	77
Tacoma	91	Panama	75
Texas	84	St. Louis	75
Oklahoma	80	Intermountain	74
Seattle	80	Mid-Missouri	73
Spokane	80	Mohawk-Hudson	72
Duluth	78	Kansas	71

Local Section	Quota %	Local Section	Quota %
Gaining Speed			
Buffalo	69	Montana	61
North Carolina	69	Toledo	59
Dayton	65	South Carolina	56
Akron	64	Miami	55
Los Angeles	62	National Capital	55
Mid-South	61	Venezuelan	55
First Gear			
San Diego	53	Michigan	46
Wyoming	53	New Hampshire	46
Mexico	52	New Mexico	46
Oregon	51	Louisiana	43
Northwestern	47	Colorado	40
Alabama	46		
Slow Start, Strong Finish?			
Florida	33	Brazil	14
South Dakota	31	Rep. Colombia	10

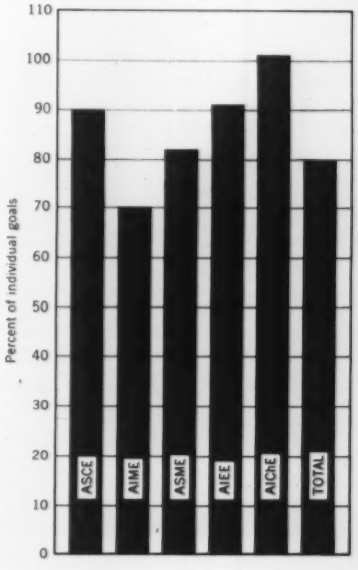


Fig. 1. As of February 11, ASCE member giving for the UEC is 90 percent completed. Total member giving has achieved 80 percent of its quota.

Waste stabilization basins

for a desert sewage treatment plant

RALPH STONE, F. ASCE, Ralph Stone and Company, Consulting Engineers, Beverly Hills, Calif.

In 1957, the construction of the planned community, Desert Lake Village, near Boron, Calif., presented the opportunity to install a low-cost sewage collection and treatment system utilizing waste stabilization basins. Desert Lake Village was developed to provide modern community housing largely for families supported by the world famous borax mines and processing plants of the U. S. Borax and Chemical Company, as well as some families connected with the nearby Edwards Air Force Base and the auxiliary Rocket Engine Test Station. These community-wide sewerage and treatment facilities were constructed primarily because preliminary engineering studies indicated they would be economical in first cost and far superior in utility to individual septic tanks and effluent drainage systems.

The planned community was to consist of approximately 250 homes, 120 hotel units, a shopping center, a primary grade school and other appurtenances. To date, about 146 homes, 110 motel units, 4 apartment houses, a primary grade school and 7 commercial establishments have been built and occupied. Tract plans are completed for building additional residences, a shopping center and other facilities.

Preliminary studies indicated that the local soils are relatively impermeable. Private septic-tank and leaching facilities in adjacent areas have required continuous costly maintenance and present a serious sanitary nuisance. Other secondary reasons for installing the community-wide sewerage facilities include: (1) the successful experience of the engineers with the nearby Mojave, Calif., experimental system of waste stabilization basins, and (2) the possible need for reclaiming water to irrigate a golf course or park-type area in the arid Mojave region.

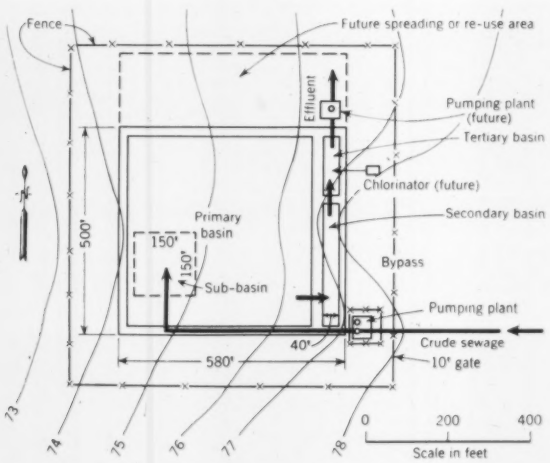
Sewerage system

The sewage collection and outfall system is designed to take advantage of the 0.6-percent slope of the natural ground surface. A pneumatic ejector-type pumping plant was installed to lift the influent into the piping system of the stabilization-basin treatment plant. The lift station and outfall were so designed that if a pumping failure should occur, the flow would be automatically bypassed into the secondary stabilization basin, as shown in Fig. 1. Thus, all the raw sewage enters the stabilization basins and there is no need for an emergency bypass into natural drainage. The waste stabilization basins were located 1,500 ft from the nearest residence and are down wind of dwelling areas.

As noted previously, the soil investigations indicated that the surface material and subsoils consist primarily of low-porosity sandy silts with discontinuous clay lenses. Some spread water from the surface treatment and spreading basins can and does directly recharge the ground-water aquifers. The community water supply is derived from deep wells located over 500 ft from the disposal plant. The water-well casings and pump bases are installed

Center subbasin of the primary stabilization basin is seen filled (1958). in plant of Desert Lake Community Services District, near Boron, Calif. Gravity inlet appears at right and subdivision homes are in background.

FIG. 1. Stabilization-basin sewage treatment plant for the Desert Lake Community Services District, Boron, Calif.



so as to minimize the possibility of direct pollution or contamination. The stabilization basins are designed to fully utilize the mixing ability of the prevailing wind, which normally blows from the southwest at an average velocity to 13 mph. Other climatological data utilized in the design of the stabilization basins include temperature, which normally ranges from a minimum of 5 deg to a maximum of about 118 deg F. The normal annual precipitation is 7 in., and the average annual evaporation is 117 in.

The waste stabilization basins are planned for a total average flow of 0.15 mgd and a maximum peak flow of 0.4 mgd. The basins are located so that they can be enlarged to treat increased flows. The primary basin, shown in Fig. 1, covers a wetted area of 4.5 acres and maintains a minimum liquid depth of 3 ft with a 2-ft freeboard. An inlet subbasin, 150 ft x 150 ft, was excavated off center in the primary basin to provide an additional water depth of 4 ft at the inlet, or a total minimum depth of 7 ft in the subbasin, into which the incoming raw sewage is discharged. This arrangement greatly reduced the excavation cost, while at the same time it improved the depth diffusion of the raw sewage.

The primary basin has an average theoretical design detention time of more than 30 days and a five-day BOD (bio-chemical oxygen demand) loading of less than 60 lb per acre. The secondary and tertiary basins, which can be operated in series, supply further effluent treatment. As shown in Fig. 1, the wetted area of the secondary basin is about 40 ft by 280 ft and that of the tertiary basin is about 40 ft by 120 ft. Both have a minimum liquid depth of 3 ft and a 2-ft freeboard. As previously observed, the secondary and tertiary basins also provide flexibility of operation by permitting additional bypassing, percolation and evaporation of the waste water. Thus the raw-sewage inflow can be handled in parallel as well as in series. Provision has been made for possible future pumping and chlorination of the reclaimed water or outflow from the tertiary basin.

Operation problems overcome

The Desert Lake Community Services District was established in 1958 to operate both the water and the sewage handling facilities. The effectiveness of the system of waste stabilization basins has been proved by continuous operation for about three years. From 1957 to 1958, for one year after construction, the developer operated the sewage utilities and minimum provisions existed for maintaining the system.

Operating problems encountered as a result of lack of maintenance included erosion of the earth-dike inlet structures and deposition of organic solids on the surface of the basin. Both difficulties were partially caused by inadequate water depth due to insufficient sewage flow. At that time, minor local odors and flies were present. In 1958, the Desert Lake Community Services District was formed to operate the public utilities. The author's firm was then retained, and continuous supervision was provided, including periodic visits and sampling. Remedial measures included the construction and maintenance of small subdikes within the large primary basin to develop a minimum water depth of 1 ft. This eliminated the stranding of suspended solids in the basin soils with the result that there has been no recurrence of odors, flies or other nuisances.

Raw sewage from the plant has averaged some 200 ppm of hardness and a relatively high sodium content. Its five-day BOD averages about 200 ppm. In the basins, the total nitrogen ranges from 75 to 100 ppm, and Chlamydomonas algae have consistently predominated. With normal summer air and water temperatures in this desert region, Euglena, chlorella and sulfur bacteria have also appeared in certain of the basins.

Costs low

The cost of the entire waste-stabilization-basin system, including the pumping plant, automatic controls, fencing, piping and all other facilities, is reported by the developer to have been less than $15,000. The cost of operation including consulting services has been less than $1,000 a year. In contrast, nearby communities with similar population, topography, soil, and sewage-flow characteristics report the costs of maintenance for individual septic tanks and leach systems to be as much as $15,000 annually.

Conclusions listed

Considerable experience at some six installations of waste stabilization basins, including the Desert Lake system, indicates the importance of a relatively deep primary basin to receive and treat the raw sewage.

A deep, well designed basin will have the following advantages:

1. A larger quantity of dilution water per unit surface area.
2. Better mixing by wind or thermal mechanisms and hence improved reaeration of basin waters.

Precast concrete manhole and concrete-block pump station for Desert Lake Village are seen during construction.

Yeomans' pneumatic ejector pump has been installed in pump-station pit, lined with concrete block.

3. Conservation of the generated algal oxygen by providing good mixing and preventing oxygen supersaturation losses to the surface water.

4. Control of floatable material by thermal diffusion, by reduction in the temperature of the inflowing raw sewage as it comes in contact with the colder deep bottom waters, thus cooling the warm solids and minimizing their tendency to rise to the surface.

5. Greater storage capacity in the receiving basin with resulting improved flow control in the operation of the treatment plant.

6. Increased detention time and destruction of pathogenic organisms by natural causes.

7. Configuration to utilize subbasins within the larger primary basin for low-flow start-up conditions.

8. Improved segregation of aerobic, algal and bacterial organisms by permitting withdrawal from possible thermocline-separated bottom waters.

9. Greater adaptability to canyon sites or those with irregular topography.

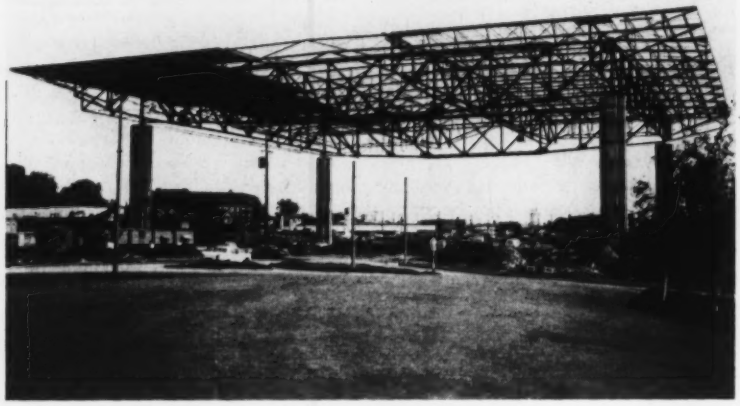
10. Greater algal and bacterial activity and treatment efficiency than in a shallow basin of equivalent area.

11. Better control of swamp-type vegetation and inhibition of insect breeding.

12. Greater storage capacity for treated-effluent disposal or reclamation.

The realization of these advantages for a deep-water stabilization basin is of course predicated on proper engineering design, construction and operation. Obviously an anaerobic basis, whether deep or shallow, is noxious. Poorly designed deep basins are more costly, will short-circuit, and may have no more value than a shallow basin. It should be noted that a review of the literature shows most authorities in the field in favor of shallow stabilization basins.

We wish to acknowledge the cooperation of W. Ray Hays, developer, and Hal B. Hays, contractor, who were instrumental in constructing the Desert Lake Village sewerage system. Prof. Robert C. Merz and Dr. Raymond Zehmpfennig, of the University of Southern California, have cooperated in analyzing effluent samples for algal and mineral content. John Legget, Executive Officer, Lahontan Region, California State Water Pollution Control Board No. 6, and H. Allersmeyer, Kern County Sanitarian, assisted in project planning. L. L. Thomas, President of the Desert Lake Community Services District, is responsible for operating the system. Other governmental agencies and their staffs have generously assisted in this modest project.



Structural steel system for roof of Arena Building is in place.

PORTLAND

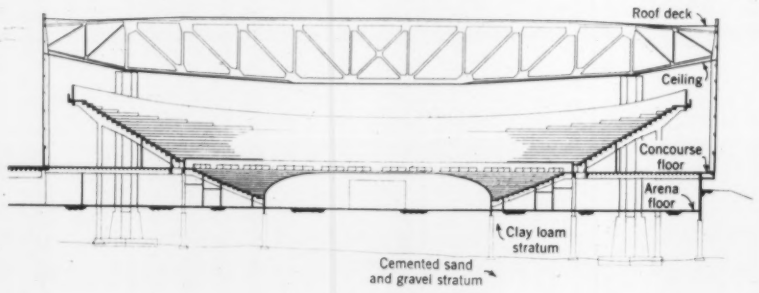
JOHN T. MERRIFIELD, F. ASCE, Chief Engineer

Steel, timber and prestressed concrete are used for two unusual structures of the Portland (Oreg.) Memorial Coliseum. The Arena Building—360 ft square, 105 ft high, with cantilevered steel frame, laminated timber mullions and aluminum sash—will give the eastern skyline of Portland a new look. Also included in the project is a one-story Exhibit Hall, 135 ft wide and 420 ft long, with provision for future expansion. The 21-acre site will provide parking space for 1,800 cars, some of it on the Exhibit Hall roof.

The purpose of this project is to give Portland a long-needed facility to house sporting events, trade shows, conventions and other activities involving large public gatherings. The Arena will have 8,500 permanent seats in the concrete seat-deck bowl. Temporary seats will increase the capacity to 10,500 for hockey, 12,500 for basketball and 13,500 for boxing. The Exhibit Hall will provide 56,500 sq ft of display space for trade shows and conventions.

As shown in Fig. 1, a typical cross-section through the Arena Building, the arena level contains meeting rooms,

FIG 1. Arena floor contains meeting rooms, dressing rooms, and maintenance areas, here seen in typical cross-section. The concourse floor provides open space around the seat-deck bowl for access to it.



In architect's sketch of the Portland Memorial Coliseum, on-grade parking mall in foreground extends over onto roof of Exhibit Hall. Seat-deck bowl will present a dramatic picture through the extensive glass walls of the Arena Building.

MEMORIAL COLISEUM

Moffatt, Nichol and Taylor, Consulting Engineers, Portland, Oreg.

team and dressing rooms, service space and mechanical rooms. The concourse floor provides open space around the bowl for access to the seat deck. This space can also be used for displays.

The lower floor of the Exhibit Hall, although constructed to provide display space, can also be used for the parking of vehicles. The roof deck of the Exhibit Hall, which is at the same level as the concourse floor of the Arena Building, provides vehicular access to this concourse floor and parking for all types of vehicles.

The Exhibit Hall is a reinforced concrete structure with columns spaced 30 ft on centers each way to provide for display space and vehicular parking. The roof deck is designed for H20 highway loading to accommodate buses and fire trucks. Conventionally reinforced concrete closure beams span 30 ft between columns and support prestressed, precast concrete channel units, which span 30 ft between the beams. The prestressed concrete channel units were placed on the beam forms, and continuity for live load in the channel units was developed by extending top bars from the prestressed units and bonding them in the closure beams. Thus the prestressed concrete units are simple spans for dead load and continuous spans for live load. The prestressed units contain diaphragms at the supports and at the one-third points of each span.

Each diaphragm, at the one-third points of the span, contains two post-tensioned cables prestressed across the width of the building. Each precast concrete channel unit contains a tapered recess at the top edges to provide a longitudinal grout pocket with the adjacent unit, which will distribute concentrated loads. On completion of grouting, the deck will receive a waterproofing membrane and a 1½-in. asphaltic concrete wearing surface. An expansion joint across the building is provided by setting the ends of the prestressed units on neoprene bearing pads 1½ in. thick, supported by a beam corbel.

The foundations for the Exhibit Hall structure are spread footings designed for a low soil pressure. The foundation soil pressure was carefully balanced by varying the area of the footings and the depths at which they were placed. The Exhibit Hall building is in effect a daylight basement with the west wall open and the east wall serving as an earth retaining wall 20 ft high. The retaining wall is supported at the top by the roof deck and at the bottom by the concrete floor slab and struts to the interior column foundations. The lat-

Covered by the massive roof structure, concrete construction on the Arena Building concourse floor gets under way. Average winter temperatures of 40 deg F allow year-round construction.

eral loads imparted to the roof-deck diaphragm by the retaining wall are resisted by the reinforced concrete beams and columns acting as rigid frames.

Arena Building

Since the column and pier loads in the Arena Building are much greater than those in the Exhibit Hall, the foundations for the Arena Building are founded on a cemented sand and gravel stratum some 20 to 25 ft below the arena-floor level. Foundations for the perimeter walls and the interior reinforced-concrete floor framing and seat-deck structure are drilled and belled caissons 24 or 30 in. in diameter. The size of the belled bottoms vary to take advantage of the 16,000 psf of allowable soil pressure on the bearing stratum. Foundations for the four roof piers consist of spread footings 24 ft square by 4 ft deep, placed on the cemented sand and gravel stratum at 45 deg to the principal axes of the building. The maximum edge soil pressure of these spread footings is also 16,000 psf.

The concourse floor framing and the ramps to the arena level consist of conventional reinforced-concrete pan joists, beams and columns. This floor framing was designed for a uniform live load of 100 psf or a 10,000-lb concentrated load to allow for the use of fork-lift trucks.

The seat-deck bowl surrounding the arena consists of conventionally reinforced precast seat-deck units supported by poured-in-place seat-deck beams. The seat-deck units will be placed on the seat-deck beams and closure units will be poured between the ends of the seat-deck units at the tops of the beams. The entire seat-deck bowl is inside the four roof piers, so that the view of the arena from all the seats is unobstructed by columns.

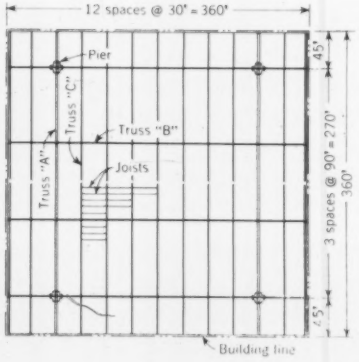
The roof framing is 360 ft square and is supported on four reinforced concrete piers which are 240 ft apart in one direction and 270 ft apart in the other. The reinforced concrete piers are in the shape of a cross 12 ft 6 in. wide; the projections of the cross are 5 ft on a side. Each pier contains five void spaces, which accommodate mechanical and electrical ducts leading to the ceiling area. The southwest pier contains a hydraulic elevator which operates from the floor of the arena to the top of the pier.

The roof piers are designed to transmit the lateral loads as cantilevers from the roof system to the footings. The bearing device for the roof structure consists of a 10-in. stainless-steel hemisphere which provides a ball-and-socket joint at the top of each pier. The surface between the bearing plate containing the hemisphere and the base plate is lubricated to allow movement during construction until the entire dead load is taken by the roof structure. The temporary blocking will then be removed and the bearing plate will be welded to the base plate.

Roof framing system

The plans and specifications gave the contractor the option of using structural steel or glued laminated timber trusses for the roof framing system. He chose the structural steel. The sketch of the roof framing system, Fig. 2, shows the two A-trusses spanning 270 ft and cantilevering 45 ft, the four B-trusses spanning 240 ft between the piers and the A-trusses and cantilevering 60 ft, and the 22 C-trusses spanning 90 ft between the B-trusses and cantilevering 45 ft. The A- and B-trusses contain many members of A242 steel to save weight and provide economy in the system. Other members in the A- and B-trusses and all members in the C-trusses consist of A7 steel. Shop connections for the A- and B-trusses consist of rivets or high-tensile bolts with field connections limited to the high-tensile bolts. The C-trusses are shop connected by welding, and field connected by high-tensile bolts. The chord members of the A- and B-trusses near mid-span consist of two 14-in. wide-flange sections, placed one on top of the other, with the flanges vertical and welded together where they meet. The largest chord section in the top chord of the A-truss consists of two 14WF314 members of A242 steel.

FIG 2. Sketch of the roof framing system for the Arena Building shows two A-trusses spanning 270 ft and cantilevering 45 ft; four B-trusses spanning 240 ft between piers and A-trusses and cantilevering 60 ft; and 22 C-trusses spanning 90 ft between B-trusses and cantilevering 45 ft. Macomber Allspan joists spaced 7 ft 6 in. on centers were used to span the 30 ft between C-trusses.



Macomber Allspan joists, at 7 ft 6 in. on centers, were used to span the 30 ft between C-trusses. The roof deck placed over the joists consisted of 24-gage galvanized Granco Tufcor steel decking covered by 3 in. of vermiculite concrete weighing 27 lb per cu ft and having a minimum compressive strength of 125 psi. The steel roof decking was welded to the joists and the C-trusses with regular welding clips. Special welding clips were employed to weld the roof deck to the A- and B-trusses on the column lines to provide for the diaphragm loading of 550 lb per lin ft. The vermiculite-concrete roof deck was then covered with a built-up roofing. A roof drain of 8-in. diameter is provided at each roof pier.

The perimeter walls of the Arena Building consist of 9-in. x 35¾ in. glued laminated timber mullions at 15 ft on centers, spanning 82 ft from the concourse floor to the roof deck. Horizontal glued laminated members, aluminum sash and glass will be placed between the mullions up to the bottom of the roof trusses and the area above that will be covered with aluminum siding. The timber mullions are designed for a trapezoidal wind load varying from 20 psf at the concourse floor level to 25 psf at the roof-deck level. The mullions are hinged at the concourse floor level by means of a 6-in. pipe dowel and a ½-in. Fabreeka pad. The tops of the mullions are attached to the roof diaphragm with vertical sliding joints, employing stainless steel surfaces, to eliminate vertical load on the mullions from the roof structure.

Who did it

General contractor for the project is the Hoffman Construction Co. Some of the principal subcontractors in the structural engineering field are: structural steel fabrication, Poole, McGonigle & Dick; structural steel erection, Steel Construction Co.; prestressed and precast concrete units, Empire Prestressed Concrete Co.; roof joists, Portland Wire & Steel Co.; steel roof deck, Mercer Steel Co.; Vermiculite roof-deck concrete, Vermiculite-Northwest Inc.; and concrete, Highway Ready-Mix Co.

Architects for the project are Skidmore, Owings & Merrill of Portland. The structural engineers are Moffatt, Nichol & Taylor; electrical engineers, Grant Kelley & Associates; mechanical engineers, J. Donald Kroeker & Associates, all of Portland.

The scheduled completion date is November 1, 1960. To date work is on schedule.

Permanent steel used as subway shoring

HENRY GOLDFINGER, F. ASCE

Project Manager

Spencer, White & Prentis, Inc.

New York, N.Y.

A most difficult project recently completed in the city of New York involved underpinning and shoring for a new depressed track under an operating subway while subway trains were running on an unreinforced concrete mat overhead. An ingenious plan evolved by Spencer, White & Prentis, who performed the work, eliminated shoring, track work, signal changes, electric alterations and other work inside the operating subway by modifying the permanent steel roof-beams for the new track to serve as temporary supports.

The new track crosses diagonally, at a sharp angle, under the existing four-track BMT subway (Figs. 1 and 2). Although the four-track subway is only 60 ft wide, the diagonal length under it is 155 ft. Subgrade of the new structure is 51 ft below the street and the underpinning walls are 2 ft below that. Near the subgrade depth a fine water-bearing sand with some silt, commonly known as "bull's liver," was encountered. Ground-water was encountered 22 ft above subgrade.

Only 1 in. to 5 in. of headroom between the top of new steel and the bottom of the subway, and in some places no room at all, presented a problem in the placing of temporary needle beams under the existing structure. This was solved in an unusual manner by incorporating the roof-beams for the new track in the underpinning system. The design roof beams were increased in size and length so that they could temporarily carry the subway load and transmit it to the underpinning retaining walls during construction of the new track. Eventually they would transmit the load to the completed new foundation. Where the track is partly under and partly outside the existing subway, the outside ends of the roof steel were supported on steel seats fastened to the soldier beams driven by the general contractor.

The method devised required no shoring or other work inside the subway—a very important advantage, since it eliminated the danger that is ever present where work is performed alongside moving trains carrying thousands of people. Delays to trains necessitated by such operations were also eliminated.

Before the underpinning operations were started, an excavation was made on each side of the subway to within 6 in. of the bottom of the existing concrete walls alongside the subway. The street was decked to maintain traffic, and a pumping system was installed utilizing eductor well points.

The first operation was to underpin the outer subway walls by temporary and permanent Pretest cylinders of 14 and 16-in. diameter. These cylinders

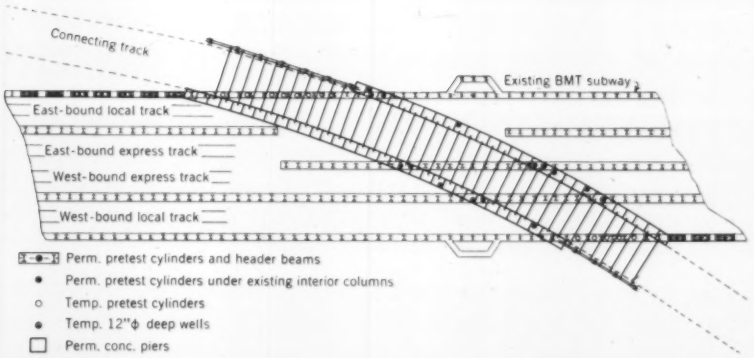


FIG. 1. Plan of underpinning for new subway running at an angle under existing four-track BMT Subway.

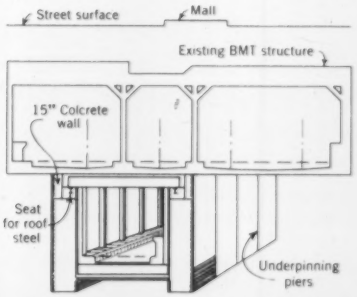


FIG. 2. Typical section of underpinning and shoring for new track under BMT Subway.

were jacked down underneath the walls outside the net lines of the new track to a depth of 5 to 20 ft below the bottom of the walls of the permanent structure. Each permanent pile was then capped with a steel beam, forming a tee to support the subway columns in pairs. Temporary Pretest cylinders were installed under the walls between net lines and so located as not to interfere with erection of permanent steel.

Pretesting is a process invented in 1916 by Lazarus White and Edmund A. Prentis, Members ASCE, by which a foundation or underpinning element is hydraulically tested to a predetermined load and then, while the test load is still maintained, but after settlement has ceased, is wedged against the structure before the testing device is removed. In underpinning with Pretest cylinders, as was done at Chrystie Street, open-end steel pipes were jacked to a predetermined depth below the influence line or subgrade of the new subway using the existing subway for reaction.

Each pipe in place was cleaned out, filled with concrete, and tested by hydraulic jacks to a 50-percent overload. A steel wedging beam was installed between each pipe and the subway structure above. Then the load was transferred from the jacks to the beam by plates and wedges, after which the jacks were removed. The wedging beam and the top of the pile were then encased in concrete.

Construction of a concrete retaining wall 4 ft wide under the subway on each side of the proposed new track was accomplished by the pit method working from access tunnels dug under the subway simultaneously from each side along each net line. The tunnels were 5½ to 6 ft wide and about 6 ft high, with temporary posts set to carry the unreinforced subway slab above. The tunnels were dug in advances of 10 to 15 ft so as to open only limited sections at a time. Pits 5 ft x 4 ft were dug to a point 2 ft below the subgrade of the new track and filled with concrete to the floor level of the access tunnels. Steel posts were then installed and anchored over each concreted pit to support the subway structure above. This procedure was repeated, one pit at a time in each tunnel, working from each end toward the center, until the 4-ft-wide concrete retaining walls were completed on both sides.

The excavation of pits and building of concrete piers were omitted at intermittent points where these piers were not required. Inter-pier wood sheeting was substituted and installed during general excavation for the new track. This was done where light loads made it possible to provide drainage through the walls, thus preventing the building up of hydrostatic pressure behind the walls. In addition, 3-in. weepholes, screened on the outside of the walls and packed with gravel, were installed in the concrete piers—also to reduce hydrostatic pressure.

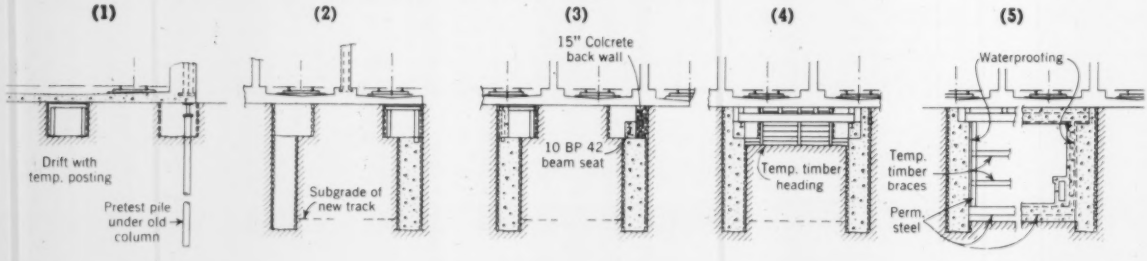
Where the retaining walls pass under interior wall columns, permanent Pretest cylinders of 14 and 16-in. diameter, similar to those in the outer walls, were installed to carry the heavier column loads.

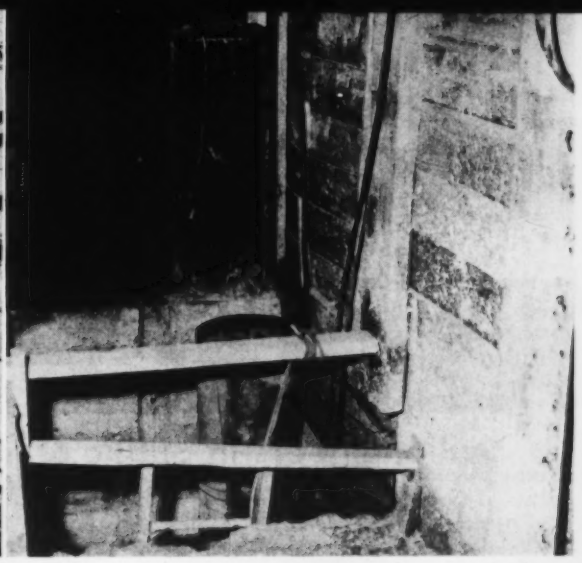
In excavating the underpinning pits, it was found that ground water could not be lowered sufficiently by the eductor well-point system to permit excavation to subgrade in the dry. Some 2 to 3 ft of water remained in the bottom of each pit. Even the installation of six points in the bottom of an underpinning pit failed to lower the water sufficiently. Therefore Spencer, White & Prentis installed deep wells of 12-in. diameter in six of the pits. These deep wells were installed by jacking open-end steel pipe of 24-in. diameter down from the water level, working within the underpinning pits to approximately 10 ft below subgrade. The pipe was then cleaned out and a 12-in. perforated pipe screen was inserted in it. The space between the screen and the pipe was filled with special sand and the 24-in. steel pipe withdrawn. The screen was extended to the top of the pit by a 14-in. lightweight pipe and the pit concreted. An enlarged eductor well point, called a mop, was then lowered into each deep well and connected to an individual pump or to the job pumping system. These wells pulled the water down to subgrade within a radius of 20 to 25 ft, which permitted the completion of four or five pits before water was again encountered above subgrade. The general contractor also found it necessary to utilize these wells to enable him to complete the new track in the dry.

Next a 15-in. concrete wall was erected on the completed piers along the outer sheeting line of the access tunnels to the under side of the subway by the Colcrete process. This method involves placing of the stone aggregate first, and then in a single operation injecting grout through the aggregate from the bottom up, converting the mass into a rich concrete. The Colcrete process was used for this wall because of the difficulty of transporting and placing concrete in a confined, long (155 ft), low, and narrow tunnel.

On this project stone of 1½-in. minimum size was placed to the under side of the subway slab simultaneously with the building of the wall forms. Grout consisting of 1 part of cement, 2 parts of sand, and 6 gal of water per sack of cement was mixed at 1,800 rpm by a DD8 high-speed Colcrete mixer and injected by a Colmono No. 10 pump through 2-in. grout pipes to fill the voids in the stone. Colcrete mixers produce a stable fluent cement-sand grout by means of colloidal or high-shear mixing. No additives are necessary or used. Tests of the concrete placed in this manner showed it to be far better, for the same cement content, than that specified by the Transit Authority, with a strength of 5,000 psi at 14 days and over 6,200 psi at 28 days.

FIG. 3. Sequence of operations is shown in five steps.
STEP 1. Excavate tunnels and support existing structure
STEP 2. Excavate and place concrete piers
STEP 3. Build 15-in. Colcrete wall and steel-beam seats
STEP 4. Install permanent roof steel; transfer load of BMT structure to steel
STEP 5. Excavate between walls to subgrade; install rest of structural steel and concrete





Start of west tunnel under existing BMT subway (photo above) is marked by horizontal wood sheeting and steel supports for the subway structure, above. In tunnel under existing subway (photo at right), underpinning cylinder in the excavated pit in the foreground is ready for concrete and pretesting, before the subway load is transferred to it. Directly behind pit, a completed cylinder and pier are carrying subway load. A steel post and deep well are in background.

The remaining space over the retaining walls, 2 ft 9 in. wide, was filled with concrete to the elevation of the bottom of the new roof steel for the full length of each tunnel. A continuous 10-in. steel beam was incorporated, as a seat for the new roof steel.

Next, roof steel spanning the area to be excavated for the new track was erected on the retaining-wall seats. The beams were set one at a time, again working from the outside towards the center, the subway load being transferred to each beam before the next one was installed. To install each beam, the earth core between the retaining walls was excavated for a depth of 6 ft below the existing subway slab, and for an advance of 5 to 6 ft. The face of each advance was sheeted and temporary shoring was placed using lightweight aluminum hydraulic jacks. This shoring, placed under the subway slab and columns, was located so that it would not interfere with the setting of the new steel.

After a beam was set in place, it was blocked at each end and the subway load was transferred to it by plates and wedges. This process was repeated, as mentioned above, one beam at a time.

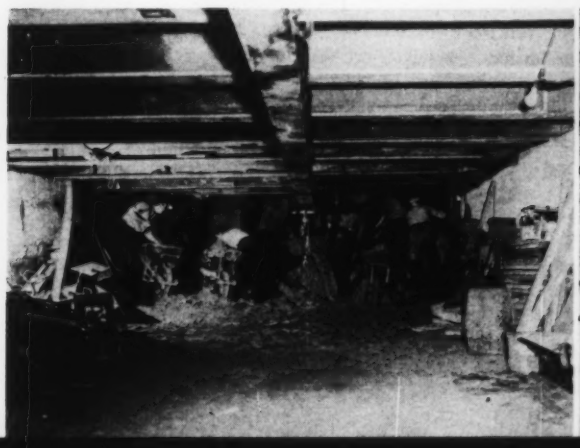
With all the roof beams in place, the general contractor excavated the remaining earth core to subgrade by bulldozer and clamshell. Two tiers of 12-in. x 12-in. timber braces were installed as the excavation proceeded, the remaining steel columns and floor beams were erected, and the permanent structure was completed.

As a matter of interest it should be noted that the structural steel for the new track was erected in reverse order, from the top down. First, the roof beams were placed as described, then the columns were suspended from the roof beams, and finally the floor beams were suspended from the columns.

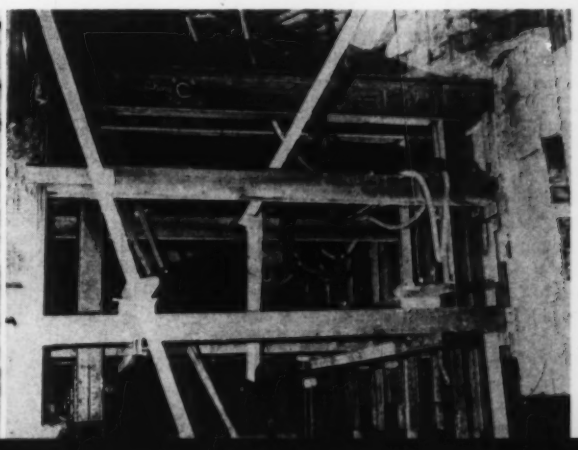
To complete the work, the load of the subway was transferred from the concrete retaining walls to the subway steel by installing plates and wedges at a number of points under each floor beam.

The work by Spencer, White & Prentis on this project—called Section 2, Route 112 of the Chrystie Street Subway—was completed in approximately five months. Work in the field was supervised first by Charles Gunther and then by Vincent Leary, Job Superintendents, under the direction of Donald B. McKinley, M. ASCE, General Superintendent, and Henry Goldfinger, F. ASCE, Project Manager. For the General Contractor, Cayuga Foundation Corp., George Schuster was General Manager. The owner, the New York City Transit Authority, was represented by Sam Freedman, Section Engineer.

Roof steel, supported on underpinning retaining walls, is in place in foreground. In back, excavating and shoring for next roof beam are in progress.



Steel columns hang from the permanent roof steel and floor beams hang from the columns. Note waterproofing on retaining wall at right.



Trends in employment conditions

in relation to remuneration of civil engineers in public practice

IRVING F. ASHWORTH, F. ASCE, Chief Engineer, Department of City Planning, New York, N. Y.

Much of the art of civil engineering has been developed in specialties related to the functions of government—local, state and national—and approximately one-third of the membership of the Society is engaged in the field of public practice.

As organizations, both public and private, grow in size and complexity, the need for good administrative practices for proper direction and control has assumed greater importance. With increases in the size of government units, developments in the field of corporate administration have been taken over into public administration, and vice versa. As a result the distinction between the organizational practices of large corporations and those of large governmental units tends to narrow in many respects. Operations and functions are regulated, levels of responsibility established, procedures laid out and personnel policies adopted, all in accordance with current administrative practice.

Of what significance is this trend to the civil engineer in public practice? The civil engineer with few or no executive duties finds, despite heavy personal responsibility in his field of activity, that the attitude toward his position tends to become more and more impersonal, and he himself is rated merely as an organizational element. In consequence, there is often little recognition of the value and quality of his work except within his own limited group.

From the organizational viewpoint, such an individual is apt to be considered merely as a technician with certain specialized aptitudes, for whom certain perquisites and a certain pay scale are pertinent, based on availability of replacement. If such an employee is not to be regarded solely as a technician, methods for recognizing the value of his work must be developed within the organization. Such recognition is necessary to the striving after excellence that is characteristic of a member of a profession.

The civil engineer in public practice, with administrative or executive responsibilities in a large organization, is confronted with complex organizational procedures. Often several layers of administrative officers intervene between the engineer and the officials with whom decisions rest; and current administrative policies and precedents may necessitate a complex approach to a project and its solution. Not only must the engineer executive be competent in his special field but also he must have an intimate knowledge of organizational structure and procedures.

Salary schedules

Elements that go into the determination of salary schedules in public practice can be discussed only briefly. It is not maintained that such elements are entirely logical or appropriate, but they do exist. Currently, living costs and changes in these costs continue to be the predominant influence on, and the chief stimulus for increases in salary schedules. Prevailing wage rates are often cited as probably the most important factor in the formulation of salary schedules in public employment. Normally there is a differential in favor of private employment but tenure and other benefits are often considered an offsetting feature. Of late years, the gap in benefits between public and private employment has narrowed considerably so that this element has become of diminishing importance as an equalizer. There is now a tendency in certain areas of private employment to utilize wage schedules in public employment as a base, and to add a differential to obtain a competitive advantage over public service in the recruitment and retention of employees.

Supply and demand directly affect the criterion of prevailing wage rates. In slack times public service offers advantages of tenure, whereas in times of full employment, public service is at a disadvantage in recruiting and retaining employees.

In recent years, the growing demands of our technical civilization have fully preempted the services of the annual crop of engineering graduates, recently stated as 40,000, and have demanded more. This condition is expected to continue for some time in the absence of any pronounced economic unbalance. Public agencies are now having difficulty in recruiting and retaining employees, and consequently must bolster up wage schedules in the lower grades where recruitment largely occurs, with corresponding adjustments in the salaries of intermediate grades. Only recently has public service undertaken a program of recruitment publicity and a simplification of qualification procedures.

Unselfish service

A low tax base, or heavy budgetary commitments in other areas of government activity, or both, have often been urged as necessitating low or marginal salary scales for engineers in public employ. To the credit of the profession, it should be noted that in many instances an engineering performance of high quality has resulted even though the engineer has made what amounts to a contribution to government in the form of a considerable salary differential. Evidently the ideal of unselfish service is still an active mo-

tivating principle. In spite of this ideal and the fact that living costs are lower in some areas, it is obviously inequitable to establish compensation schedules that penalize any particular group of engineers.

Policies in public service

Often old established practices are adhered to in spite of their inappropriateness in terms of present-day needs. Even now, in many instances salaries for appointive bureau heads, for legislators, and for other elected officials automatically place a ceiling on the compensation of engineering employees. This compressed pattern is clearly evident in graphs of salary levels in public service plotted against length of service, as compared with similar graphs of salary levels in private employ.

There are indications that this problem is being ameliorated through less close executive control by legislatures over government agencies, through the introduction of more objective wage schedules and more modern personnel practices, and through more frequent appointment of engineers to administrative positions in agencies heavily involved in technical fields. We know that private industry makes wide use of engineers in high administrative and executive posts. A comparison with similar positions held by engineers in public service would prove interesting and informative to the profession at large.

Salaries compared

It can be established, at least for the past decade, that the median salaries of civil engineers as a group have been lower than those of engineers in other branches of engineering. Various reasons can be given for this situation, including the relatively high proportion of civil engineers in the overall total; the relatively large number of civil engineers in relation to job opportunities; the comparative shortage of engineers in other branches in relation to expanding fields of employment; the large proportion of civil engineers in public service with relatively lower salary schedules; and perhaps the greater opportunities for engineers in other fields to secure the high-salaried administrative and executive posts available in industry.

Also during the past decade, there has been considerable improvement in the salary scales of engineers in all branches. A comparison shows that the increases in the median salaries of civil engineers have been relatively as large, percentage-wise, as those in many of the other engineering branches and in fact were somewhat larger than in most —not that such increases succeeded in wiping out the median salary differentials between the civil engineers and the engineers in other branches. In some branches the percentage of the differential has been somewhat reduced, but in others it remains relatively the same. It may be inferred that current trends in technological employment favor the other branches over civil engineering.

It is impracticable to forecast the permanence of this differential, but it may be rationalized as the resultant of the current balance of public and private expenditures for civil engineering work as compared with the largely private expenditures for capital improvements, research and production in fields of activity involving the other branches. As this balance changes, so will the economic evaluation of the services of the various branches of engineering.

Salaries in public and private practice

As between the civil engineer in private practice and the civil engineer in public practice, there is another salary differential of long standing. In the median starting rates of civil engineers in public practice, this differential tends to disappear as the result of recent and continuing adjustments in the field of public service. In certain of the public areas maximum median salary rates have increased substantially, but in others little change has taken place. On the other hand, maximum median salaries have risen in private practice, thereby continuing the differential between salaries in public and private practice in this range.

It is to be noted that the economic disadvantage applicable to engineers in public practice extends even into the field of technical education, since teaching positions in public institutions are subject to an adverse salary differential as compared to similar positions in private institutions.

An encouraging factor is the continuing awareness of the salary needs of the civil engineer in both public and private practice. The recruitment area is the one currently receiving remedial action, particularly in public practice. In private practice it has been feasible not only to meet competition in the recruitment area but also to advance wage rates in the intermediate area.

Retirement and fringe benefits

Closely allied to the question of salary compensation is the question of fringe benefits, of which probably the most important is retirement pay. Heretofore retirement has not bulked too large in the consciousness of professional people as a whole since their value tends to grow with length of experience. Again, many are reluctant to substitute inactivity for the exercise of a rigorous and exacting profession.

Nevertheless there is a nation-wide trend toward retirement at age 65, as exemplified by the policy of large corporations and the Federal Government. In the larger public agencies and large corporations retirement provisions have been in effect for a considerable time. In those areas consequently retirement benefits have been taken into consideration as an element of remuneration.

With increased economic stability, many private firms are introducing or have introduced retirement benefits as a feature of employment. Such benefits are under consideration by others. There is a natural reluctance on the part of some to initiate such a policy because of the recent establishment of the firm or because of uncertainty as to its future employment requirements. It would seem, however, that actuarial practices are sufficiently adaptable to permit the formulation of a standard employee-employer policy that would permit the employee to carry policy benefits from job to job. The premium, or any part of it, might be contributed by an employer if he so elected. This might solve the problem for the new or the small organization and protect the employee in the event of a lay-off or a change of employment.

Retirement benefits in the smaller public agencies are difficult to assess since much depends on local concepts of employee welfare, the adequacy of the tax base of the governmental unit, and the presence or absence of enabling legislation. It is to be noted that public employees are not eligible for the modest benefits of the Federal System of Social Security unless special action is taken by their local government agency.

In outlining current factors that influence the remuneration of civil engineers, the writer has doubtless been tempted into some observations that are the product of his own limited experience. Further study to develop a broader basis for the understanding of current trends will be thoroughly worth while and will be of great benefit to the Society and its members.

The most casual survey of the world's needs indicates a limitless field for the services of the civil engineer. The big question is, "How will the civil engineer be rewarded for providing these services?"

(This address was originally presented by Mr. Ashworth at the ASCE Annual Convention in Washington, D. C., before the Conditions of Practice Department session sponsored by the Committee on Employment Conditions and presided over by Waldo G. Bowman, chairman of the Department.)

Open-web beams for a Seattle office building

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Use of open-web steel beams spanning 56 ft 4 in. and weighing over two tons each resulted in savings in weight in the construction of the newly opened Washington Building in downtown Seattle, but increased the erection costs over what would have been required for a building frame of ordinary construction. These beams enabled the designers to reduce the floor-to-floor height by routing all utilities through the openings, but at the same time greatly increased the erectors' problems. An unusual amount of wire rope and other bracing was required to stabilize both the columns and the open-web beams, and the rate of erection of the steel structure was limited to the ability of the general contractor to pour the concrete floors and walls, as it was deemed unsafe to permit the derrick to operate more than six floors above a poured and set slab.

Shown here under construction is the recently completed Washington Building in Seattle, Wash. The use of open-web steel beams spanning the width of the tower part of the building resulted in considerable savings for the builder.

These unusual beams were fabricated from 18 WF 50's, which were cut in zigzag fashion along the web. The two halves were then offset and welded together to give a new web depth of 27 in. Stiffeners were added at the seven openings on each end of the beam; the ten midspan openings have no stiffeners. Reinforcing bars, bent and welded to the top flange, assure composite action with the poured-in-place floor slab to increase the compression strength. Finally a cover plate 6½ in. × 1 in. was welded to the bottom flange.

The open-web beams are used in the 21-story office tower rising above the lower four floors, which will be devoted to a 350-car parking garage and to commercial rental space. Included in the construction of the building were elements of structural steel, poured-in-place concrete, and precast prestressed concrete beams. The precast prestressed beams span the width of the tower from east to west, with a maximum span of 56 ft 4 in. Typical beams are 30 in. deep and 10 or 12 in. wide. The heaviest weighs 10.7 tons. These beams were shipped by truck from the casting yard at Tacoma, Wash., and erected by guy derricks. From the 5th to the 21st floors, open-web steel beams also span the width of the building.

These beams, both steel and prestressed concrete, are simply supported at the columns. The concrete beams rest on angle seats and the steel beams are framed to the column webs, held by machine bolts of ⅞-in. diameter. In neither case was any attempt made to develop a moment capacity in the connections (which resulted in an unstable structure). Both concrete and steel beams are provided with reinforcing bars (shown in a photograph) on top to develop composite action with the poured floor slabs.

During the pouring of the slabs, concrete beams were shored snug and level at the quarter points and at the center. The open-web steel beams were shored at the center only and jacked to a ½-in. camber before the slab was poured. After the concrete had gained strength, shores were relaxed to allow the slabs to act with the beams in picking up construction loads to be applied later.

Cambering was done by the general contractor with journal jacks of 50-ton capacity acting on 10 × 10 Douglas-fir shores, about 8 ft long. During cambering operations, the load lifted by the jacks included the floor actually being cambered, plus those beams above which had to be shored to carry the load of concrete forms, the plank used by the steel erector, and miscellaneous tools, equipment and material.

Structural-steel columns extend vertically from base plates on top of the spread footings for the entire height of the tower. The heaviest sections at the bottom are 14 WF 426, each side of the web being reinforced with plates 2½ in. thick. These sections carry plate girders spanning a door opening. Typical bottom column sections are 14 WF 264. The columns diminish in size with each successive tier (two floors) of steel. Typical columns from the 20th floor to the roof are 14 WF 43. All column splices are full butt welds.

Columns are spaced 9 ft on centers along the side walls. Spanning this 9-ft distance are "butterfly" spandrels,

welded in the shop to the columns and bolted at midspan in the field with high-strength bolts of 1-in. diameter. These spandrels, together with the welded columns, form a moment-resisting frame for lateral loads in the north-south direction, along the length of the building.

For transverse lateral loads, the structure relies on the reinforced concrete walls at the north and south ends of the tower, and on a reinforced concrete elevator core near the center. Floor slabs will transmit lateral loads into these elements. For the end walls and elevator tower, concrete was placed by the slip-form method. The typical slip included three floors, or about 36 ft, after which the forms were stopped to allow time for floor-slab construction to catch up. Slip forming was begun at the fourth-floor level. Slab forming with steel pans was begun at the fifth-floor level. Below this, all concrete was placed in conventional wooden forms.

Steel erection

During the first days of the erection operation, a truck crane was used to set base plates and to erect guy derricks. After this however, the erection of the tower was a guy-derrick operation. Two 20-ton derricks were used, each with a 110-ft mast and a 100-ft boom. Each derrick was first set up on the ground and was jumped nine times to final position on the 18th floor (a distance of 226 ft). The typical jump in the upper tower was two floors, or 24 ft.

In its second and third positions, each derrick was supported by permanent building beams previously erected but not strong enough to carry derrick loadings on the 56-ft 4-in. span. Special shoring and lateral bracing were employed under the derricks to transmit the loads back to the ground.

Beginning at the fourth derrick position (sixth-floor level), eight 36 WF 150 beams were employed to carry the derricks. Four were required at each derrick level, two per derrick. The other four were kept ready for the jump to the next level. These beams spanned the width of the building, each working beam carrying a combined dead and live loading of 26.3 tons, applied 10 in. off the center of the span, plus the uniform load of their own weight and the planking which formed a working platform. To stay the flanges of these beams against lateral buckling, gusset plates were welded to the beams, and angles bolted between the two working beams to form a horizontal truss in the plane of the top flanges. The derricks operated from the 18th floor to erect the final two tiers (four floors) of the tower.

Two types of welding machines were used. The first was an a-c transformer type delivering a rated 400 and 500-amp current, single phase. These machines were powered by a diesel generator of 100 kw delivering 440-v three-prase current. The other welding machines used were gasoline-powered d-c portable units, delivering a rated 300 and 400 amp. Compressed air was furnished by a 210-cfm rotary compressor, operating at street level with the other engine-powered equipment.

Another erection problem

In addition to the problem of the open-web beams, which did not have enough strength to carry the loading on such long spans during erection, there was a second problem—the lack of rigidity in the steel frame in the east-west direction. There is no vertical bracing along this axis, and there is no moment capacity in the connections between beams and columns. Even with moment connections, bent action would have been unreliable because of the lateral instability of the open-web beams in the 56-ft span across the building.

In working out a solution for the lack of bracing in the east-west direction, the erector decided that it would not be practicable to treat this as a column-core building, erecting one tier at a time, and stopping to wait for the concrete bracing walls to catch up.

The erector could have relied on the moment capacity of the columns, acting as vertical cantilevers above a cured slab. However, this was not considered desirable because of the derrick loadings involved, and because of difficulties in keeping the limber columns plumb. Wire-rope bracing in the vertical plane would in any case have to be used to keep the building frame plumb in the east-west direction. Columns in this same direction would be subjected to bending along their weak axes. They probably would not become effective as structural cantilevers until after the tight plumbing-up cables had yielded or broken. This consideration, along with a desire for greater stiffness in the frame, led to the design of structural wire-rope bracing, to stabilize the frame in the east-west direction at levels above the cured concrete floor slab and end walls.

Wind, taken at 20 psf on the net steel area of the side walls, proved to be the governing lateral load. Wind loads were applied equally to both walls, with no allowance for shielding, and were applied also to the derricks. Out of a total of 25 column lines, 13 were designated for vertical bracing. Shears resulting from wind loads were calculated at the even-numbered floors on each of these lines. Braced lines were chosen so that loads from derrick guys could be picked up directly, without transmittal through the building frame, and so that wind loads on the frame could be distributed as evenly as possible on all the bracing.

Bracing was arranged vertically in bays two floors, or one tier, high. Those lines, designated "A," which took east-west wind loads on the derricks, were typically braced with wire rope of $\frac{7}{8}$-in. diameter. Those lines which carried only wind loads on the building frame were typically braced with wire rope of $\frac{3}{4}$-in. diameter. See Figs. 1, 2 and 3. Heavier bracing was used between the 14th and 16th floors, with $\frac{7}{8}$-in. wire rope on the "B" lines and two parts of $\frac{3}{4}$-in. wire rope on each of the "A" lines. This enabled the erector to place eight floors of steel above a cured slab at the 14th floor, and thus to top out the structure faster after the derricks reached the 18th floor. However, it should be noted that a freshly poured slab, two formed floors and a planked floor above the cured slab added to the bracing effect, and hence to the strength and rigidity of the structure. Also, the walls were required to be formed and poured at the same time and to the same height as the concrete floor.

Any vertical bracing system such as this one relies on strut action in the horizontal members. In this case, the horizontal members were the open-web steel beams of the building frame, spanning 49 ft in some cases and 56 ft in most cases. To give them additional stiffness for strut action, a system of temporary bracing was designed. Horizontal angles were framed between two adjacent beams, to form a horizontal truss. Clips were bolted to the ends of these angles so that they could be dropped into the holes in the webs of the permanent beams. No bolts or welds were required between the temporary and the permanent members, so that installation and removal were accomplished quickly. These braces remained in place on each even-numbered floor until the steel-pan forms for the concrete slab had been placed.

After construction of the building had begun, the structural engineers retained by the owner designed another system of bracing, intended primarily to hold the open-web beams against buckling during cambering and during placing of the concrete floor slabs. This bracing is in the form of angle bridging, extending the length of the building from north to south. This bridging is on the center line of the 56-ft open-web beams, welded in the field to a stiffener previously installed to take shoring loads. It is slightly off-center on the 49-ft open-web beams. The bridging

Unusual open-web steel beams, seen in the fabricating shop, consist of 18 WF 50's cut in a zigzag fashion along the web and offset. Then the halves were welded together.

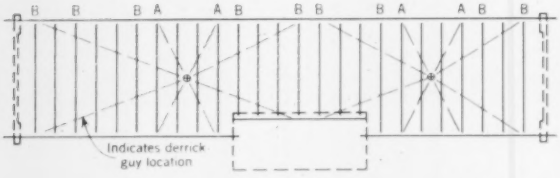


FIG. 1. Structural wire-rope bracing was used to stabilize the tower frame in the east-west direction at levels above the cured concrete floor slab and end walls. Bracing was on lines "A" and "B," shown in plan view of bracing locations. See Figs. 2 and 3 for section views.

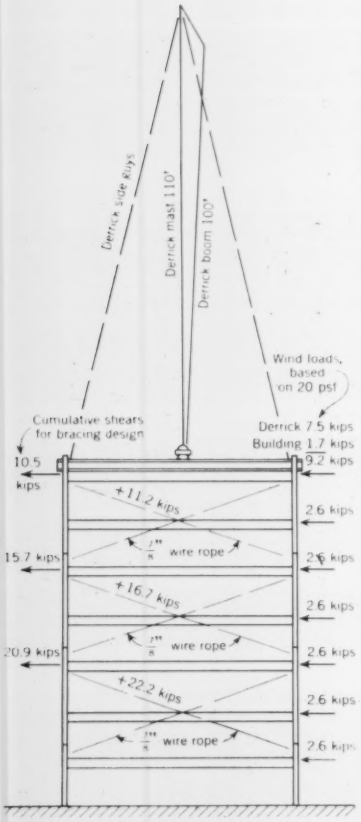


FIG. 2. The lines designated "A," which took east-west wind loads on the derricks, were typically braced with wire-rope of 7/8-in. diameter.

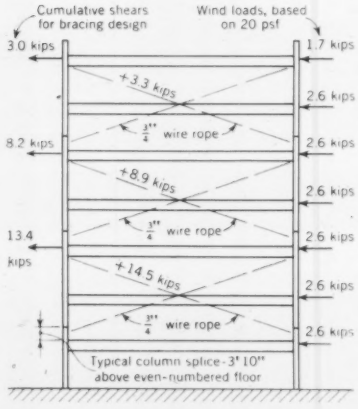


FIG. 3. The lines designated "B," which carried only wind loads on the building frame, were typically braced with wire-rope of 3/4-in. diameter.

was installed at every floor, and will remain permanently in the building.

The pace of erection was restricted by the progress of concreting on the floors below. Shoring loads that could be handled by the general contractor during the cambering and slab pouring operation were limited by the capacity of his 50-ton jacks. Specifications originally limited the load imposed from above to two planked floors, two formed floors, one open floor with shored beams, and one curing slab. The steel erector designed his vertical wire-rope bracing to conform with these limits, and thus was required to stop erection whenever the limit height was reached, to give concreting operations a chance to catch up.

Special equipment

Confronted with unusual design features, the steel erector was required to devise equipment and to employ methods that for him were unusual. Sidewall columns, spaced 9 ft on centers, were designed to carry a glass-and-marble curtain wall. To keep the columns in line, and thus present a flat base for the curtain-wall panels, the erector plumbed all columns along the west wall with a transit.

To align the lower tower floors, the instrument was set up at street level, on a line offset 2 ft from the centerline of the columns. The instrumentman could see the length of the building from north to south, and could give hand signals to the foreman of the plumbing-up crew, who directed the adjustment of turnbuckles on the wire-rope bracing to bring the columns into line. Only 13 of the 25 column lines carried structural wire-rope bracing in the vertical plane. Intermediate columns usually came into line when adjacent columns were adjusted, but occasional mavericks required extra plumbing cables.

Beginning at the tenth-floor level, the transit was operated from the building frame itself, at the level of the floor that was being adjusted. A tripod was not used, but the instrument was mounted on a steel bracket clamped to one of the column flanges. The bracket cantilevered out from the building wall, the instrument being mounted in such a fashion that it could be adjusted laterally east and west. The instrumentman, standing on a float, established his position by "wiggling in" on large targets painted on the pavement of an alley below. The instrument had to be adjusted to compensate for some movement of the column on which it was mounted, and frequent sights on the targets in the street were required.

The instrument bracket used for this

work was also used for the surveyor's leveling instrument in checking the elevation of the milling lines at the column splices.

The level rod used to check the column elevations was the same rod employed to adjust the columns laterally. A replacement tape, used to repair standard level rods, was affixed with waterproof glue to an aluminum channel, 2 in. deep and about 3 ft long. The face of the rod was coated several times with clear lacquer. This made a durable, lightweight rod, easily stored and easily carried by a rodman moving about the steel skeleton of the building.

Precast prestressed concrete beams on lower levels of the structure were lifted by the derricks by means of a wire-rope bridle, with one part of wire rope of ⅞-in. diameter leading from each end of the beam to the derrick hook. The design engineers and the concrete-beam manufacturer approved a minimum angle for these bridle legs of 45 deg with the horizontal, and so the slings were made to provide this angle for the longest beams on the job. When shorter beams were picked up with the same slings, the bridle legs were of course moved until they were nearly vertical. No spreader bar or balance beam was used. Some beams, built to cantilever a short distance on one end for special use in a garage area, were haunched at the cantilever point and had to be picked up at that point. For these special cases, short slings of a predetermined length were furnished, and were added to one bridle leg or the other so that a beam could be picked up at the proper angle.

Holes were cast in the beams at the points where they were to be lifted, so that a steel bar of 1½-in. diameter could be inserted. For the first few days on the job, a fabricated steel yoke was used to grip the ends of this bar and connect it to the wire-rope bridle slings above. Each yoke weighed 130 lb. The derrick could spot its hook directly over one end of each beam to connect the yoke, but unless the slings were disconnected it could not then reach the other end, and the other yoke had to be put in position by hand. Since this was difficult and time consuming, wire-rope yokes were designed and furnished to the field forces. These weighed about 35 lb each, and performed very well.

Two concrete beams were so located that neither derrick could handle their weight alone at the long radius required to erect them. These beams were spotted between the two derricks, the regular wire-rope bridle was attached, and then an 8-ft, double-channel equalizing beam was attached to the top of the bridle. In this fashion the weight of the beams was shared by the two derricks and they picked up the load, boomed out and swung simultaneously to erect the beams.

Columns are spaced 9 ft on centers along the side walls. Spanning this 9-ft distance are "butterfly" spandrels, shop-welded to the columns and bolted at mid-span in the field.

In an isolated area at one corner of the site, twelve beams, on two levels, had to be erected in a position that was not accessible either to the derricks or to a truck crane standing on the sidewalk below. To solve this problem, two fork-lift trucks were lifted from the street onto the building. The truck crane in the street then handed the beams, some weighing as much as 10 tons, one at a time to the trucks. The two fork-lifts, one at each end of a beam, carried it back into the building and erected it in final position, lifting it to a maximum height of 14 ft. Under the fork-lifts, floor beams were shored and timber ramps were constructed to bridge the floor slab from floor beam to floor beam. The 4-in. slab had been designed for a live load of 50 psf.

Column splices

Special erection lugs were designed by the steel fabricator so that the columns could be held in position before the splices were welded. These lugs consisted of matched steel plates, ranging in thickness from ⅜ to ¼ in., welded to the edges of the column flanges. Those welded to the top of the lower column extended upward past the column mill line to match holes in similar plates on the bottom of the upper column. In this manner, two bolts of ⅞-in. diameter held each corner of each column splice, a total of eight bolts per splice, before and during welding. The lugs were welded to the columns in the fabrication shop, and were burned off in the field after the splices were completed.

Design drawings and specifications required only that column splices be fully butt welded. Electrodes of low-hydrogen, iron-powder type, American Welding Society classification E6018, were used on both a-c and d-c current. Magnetic particle inspection was required by the engineer for welds on all column elements over ½ in. thick. Two-man teams were employed for all column welding, one man working on each side of the column.

During the winter months of 1958-1959, when the tower was under construction at the lower levels, protection of the welding operators against Seattle's wind and rain was a major concern. Plywood sections were precut to fit around the column flanges, to make a roof for the welders, and were calked with mastic to prevent the rain water from running down the column into the weld area. Sidewalls of plywood and canvas were used.

The Washington Building is being built by University Properties, Inc., as the latest addition to its metropolitan tract in downtown Seattle. Architects are Naramore, Bain, Brady and Johanson. Structural engineers are Worthington, Skilling, Helle and Jackson.

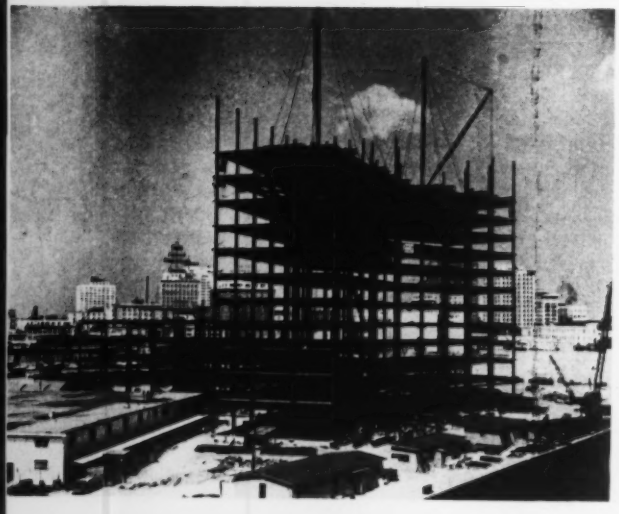
The general contract is held by a joint venture of Lloyd N. Johnson Co. and Morrison-Knudsen Co., Inc.; E. G. Collins, A.M. ASCE, is project manager and Harold Stenson, job superintendent.

Contractor for steel fabrication and erection, as well as for erection of precast concrete beams, is Bethlehem Pacific Coast Steel Corp., for which W. C. Pfaff directed fabrication of structural steel at Seattle, and C. N. Morse is District Engineer. H. I. Johnson, Jr., is Resident Engineer for the Erection Department; Allen D. Fisher is job Superintendent; and C. T. Dooley, A.M. ASCE, Field Engineer.

HOME OFFICE BUILDING FOR A RAILROAD

FEATURES:
- Steel frame with high-tensile-strength bolts for field connections
- Glass-tile facing on precast concrete panels
- Y-shaped structure to provide extra space on lower floors
- Office space of 475,000 sq ft in 15 occupied stories
- Attractive location on St. Johns River, provided by 172,000 cu yd of backfill
- Rock blasting to permit penetration of steel sheetpiles for bulkhead
- Air conditioning controls for individual office adjustment
- Large service yard with shipping facilities completely separate from main entrance
- Seven self-service elevators supplemented by escalators for first four floors

D. B. PACKARD, JR., F. ASCE, Engineer of Buildings, Atlantic Coast Line Railroad Company, Jacksonville, Fla.



Steel work is shown one month before completion of frame. Speed of erection was achieved through the use of high-tensile-strength bolts.

Site preparation for the Atlantic Coast Line Railroad Company's general office building in Jacksonville included the removal of chunks of concrete and boulders, backfilling with 172,000 cu yd of material, and construction of the bulkhead seen in foreground.

The Atlantic Coast Line Railroad is moving its general offices from Wilmington, N. C., where they have been for over a hundred years, to Jacksonville, Fla. Consideration was given to numerous places before the Jacksonville location was selected as best meeting the railroad's operating requirements. Jacksonville is near the geographical center of the system and is one of the major transportation centers of the Southeast.

A study of the operations of the general offices was made by the firm of architects selected, assisted by an engineer from the office of the Chief Engineer of the railroad. This study was developed from investigations indicating the flow of work between departments and subdepartments and within each unit. The relationship, volume, and availability of the records required for the normal functioning of each office were also considered. Other information compiled covered the number and sex of employees in each unit and the volume of incoming and outgoing mail. Estimates were made of the number of employees who would carry lunches, or eat in cafeterias or restaurants, and the number that would drive their own cars to work.

Site preparation

While these studies were progressing, plans were drawn in the Chief Engineer's office for site preparation. The location selected was on the bank of the St. Johns River, approximately at the point of curve of a sharp 90-deg bend in the stream. Slightly upstream are two bridges, the St. Elmo Acosta Highway Bridge and the Florida East Coast Railway Bridge. As these are

close together, they have a common fender system for the protection of their draw spans.

The building site had been occupied by railroad waterfront facilities, and when these were abandoned it became filled with debris from destroyed concrete coal chutes, old tank pedestals, and material from the widening of cuts along the right of way. Chunks of broken concrete and boulders approaching jetty stone in size had been dumped in among the old wharf piling. Since the available ground area was insufficient, permission was obtained to straighten out and extend the bulkhead line, thus increasing the land area by about two acres.

Core borings taken

Core borings showed that the debris extended down to a depth of 19 to 25 ft and in limited areas to over 30 ft. This mixture of debris and silt rested on a relatively thin layer of sand, which covered a limestone stratum at a depth of about 33 ft. The elevation of the top of this stratum was irregular and the stratum itself consisted of a soft-shell limestone with thin seams of dolomitic limestone. The cores in general crumbled. This limestone stratum varied from 3 to 12 ft in thickness and overlay a bed of marl many feet in thickness.

Since it would be impossible to drive foundation piles through the debris, the material had to be removed from the area under the proposed building and clean sand backfill placed. In cleaning up the area, over 5,000 old piles covered by the fill were also removed. Backfill was started with barge loads of fine sand dredged from the river and continued with truck loads from a borrow pit. A total of 172,000 cu yd of backfill was placed. The bulkhead was started when aboout one-third of the fill had been placed, which allowed bottom-dump barges to deliver a large amount of fill material before being blocked by bulkhead construction.

About a mile away, where a bulkhead had failed, the river had undercut the rock strata, allowing fill to escape through a cavern. Because of this and because the building would be so close to the river, the bulkhead piling was extended through the rock into the marl to seal off any possible openings.

After two 53-lb test H-piles were driven through the rock, it was realized that the rock would have to be cracked by blasting if sheetpiles were to be driven through it. This was accomplished by mounting a small drill on a barge and drilling through a casing. The water along the bulkhead line was from 23 to 27 ft deep. Since the location is close to downtown Jacksonville and since the foundations for most of the major structures are on this layer of rock, the blasting was done with three 5-lb charges of dynamite fired at different times and depths in each hole. The holes were spaced 3 to 5 ft on centers, depending on the rock encountered. After blasting, no difficulty was met in driving the sheetpiling, nor was the surface of the rock badly shattered.

Bulkhead wall

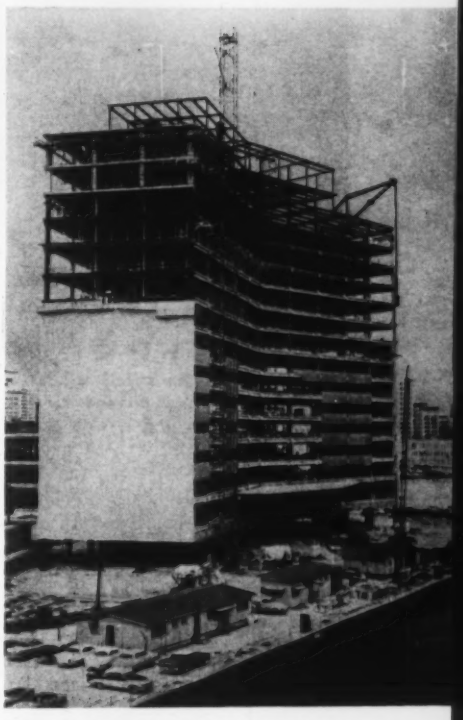
The bulkhead wall was designed using sheetpiles of Z-38 section in 54-ft and 59-ft lengths, tied back 6 ft on centers with 2-in. upset rods. The tieback anchorage for this wall was located 45 ft behind the bulkhead and consisted of 53-lb H-piles in the ratio of two tension piles to one compression pile. Compression piles were driven 9 ft on centers.

The piles were driven at an angle of 30 deg with the vertical. Compression piles were driven to a bearing strength of 90 tons or better as computed by the *Engineering News-Record* formulas. Tension piles were driven into the rock and the effort required to pull them was checked at 50 tons. Ten percent of the piles were checked for pullout and any failure required additional driving on all piles in that vicinity, and a new test. Where the tops of the piles met at the center line of the tieback system, they were encased in a concrete cap to which the tie-rods were fastened by being passed through a pipe sleeve.

The fact that the draw spans of the adjacent bridges are relatively close to the bulkhead, combined with the possibility of adverse wind and currents, could result in difficult navigation conditions at times. For this reason the bulkhead had to be substantial enough to take without damage the impact of a ship being docked in an emergency. The concrete cap that extends from 2 ft below the water line to 6 ft above was protected by timber waling and was designed as a continuous beam strong enough to take this impact. This work was completed in June 1958.

Unusual building shape

While the site was being prepared, the design of the building itself was being completed. The results of the various studies terminated in a building of somewhat unusual shape. The shape of the land, the effort to minimize the effect of the sun on the air conditioning, and the fact that extremely large offices are required for some sections of the Accounting Department, resulted in a building shaped like the letter *Y* with the stem to the north.

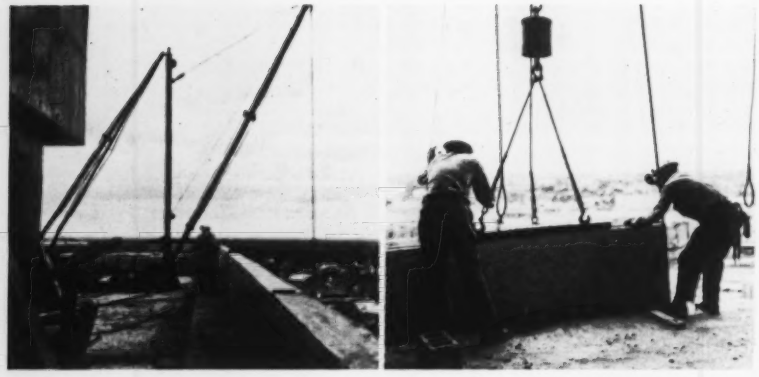


With steel work completed, work progresses on end wall of building as limestone slabs are put in place. Erection of precast concrete panels for facade has started.

The building has 17 stories—15 occupied and a two-story penthouse containing mechanical equipment. There is a basement for boilers, air-conditioning equipment and elevator pits, the floor of which is 9 ft below the river level 100 ft away. The stem of the *Y* is four stories high, thus providing increased area for the third and fourth floors, which contain the accounting section, the largest single group in the general offices.

The basement area was excavated to below the elevation of the pile cutoff, which in some areas was as much as 25 ft below river level. It had been thought that difficulty might be encountered in keeping the excavation dry with the river less than 100 ft away. A number of sand boils did break through from time to time but well points surrounding the hole kept it reasonably dry.

A total of 1,956 Raymond piles were driven into the limestone stratum underlying the area. The piles were designed for a bearing of 35 tons. The first two piles driven were loaded to 70 tons by jacking against the driver, and the load was held for 24 hours before the driving of piles was resumed.



Derrick on roof (view at left) was used to lift precast concrete wall panels into place. At right, a panel is made ready for lifting. It will be hung temporarily on cable slings until it is aligned and leveled.

The only difficulty encountered was the presence of some concrete debris not found when the area was excavated and backfilled during site preparation. This debris of course had to be removed.

Erection of 5,486 tons of steel frame was begun early in January 1959 and was completed on May 8. All field connections were with high-tensile-strength bolts. This type of frame was selected for speed of erection. The first floor, roof and penthouse floors are structural concrete slabs. All the other floors are lightweight concrete fill on Robertson Q-decking.

Exterior panels with glass tile

The end walls of the building are limestone. The larger areas along the sides are covered with precast concrete panels extending from the top of each window frame to the sill of the next window above. These panels vary somewhat in size but the greater number are 8 ft 10 in. by 7 ft 11 in. by 5¼ in. thick and weigh 3,000 lb each. They are faced with glass tiles predominately blue in color, each 1 in. by 1 in. by 3/16 in. These tiles were imported from Italy.

The panels are 5¼ in. thick, made up as follows: 3/16 in. of glass tile on the face, 1 13/16 in. of concrete, 1½ in. of fiber-glass insulation, and finally 1¾ in. of concrete. Embedded in the concrete on each side of the insulation is galvanized mesh 6 × 6 × 8/8.

Other reinforcement consists of five vertical lines of ¾-in. No. 13 gage expanded metal galvanized, a ⅜-in. rod around the perimeter, and a stainless steel frame around the front of the panel. The galvanized expanded metal is bent to form a channel 2¾ in. deep and is used to maintain the distance between the two layers of mesh and to form a tie between the front and rear concrete faces. These panels are cast face down, with the tiles in the bottom of the form. Before the concrete is poured, the tiles are covered with a layer of grout.

The panel is fastened to the building by two rows of three inserts each; at each insert the insulation is omitted so that the panel will be solid at that point. The upper three inserts support the panel and the lower three steady it and act as wind bracing. Additional small inserts are cast into the top and bottom of the panel for fastening the windows in place.

The panel itself forms the entire wall. No backing up with masonry or insulation is required on the inside of the building. The inside surface of the panel, from window to floor, is hidden by the air-conditioning unit. The metal covers of these units extend from the window to the floor and also form the window sill.

The panels are thoroughly tested. Load tests were applied on the front of the test panels to simulate wind pressure, and on the back to represent wind suction. The tests were performed with the panels in a horizontal position, and therefore the weight of the panels was considered as a part of the load. The remainder of the load was built up by loading with 36-lb concrete blocks until the combined load equaled 70 psf, or twice the design load. The panels remained under load for a 24-hr period. Deflections were negligible.

Severe tests for panels

Sample panels were tested for endurance. These tests were hot-and-cold shock tests, freeze-and-thaw tests, and impact or hail tests. The hot-and-cold shock test consisted of 25 cycles of subjection to air in a circulating oven at 140 deg F for a period of 4 hr followed by a water spray at about 55 deg F for 3 min. The panels were inspected after each cycle.

In the freeze-and-thaw test the sample panels passed through a series of cycles consisting of spraying with water at 55 deg F for 1½ hr followed by retention in a cold cabinet at minus 15 deg F for a period of 4 hr. After each cycle they were examined for defects.

The impact or hail test consisted of dropping 45 lb of gravel of ⅜-in. diameter on the glass tile face from a height of 25 ft. The gravel had been conditioned by cooling for 4 hr at zero deg F. For this test the face of each panel was inclined at an angle of 20 deg with the vertical. The panels had also been conditioned, at 30 deg F for 24 hr. The panels passed all these tests satisfactorily and were approved for use in the building.

The panels were lifted into place by a small derrick on the roof and hung temporarily on cable slings until they could be aligned and leveled. When this was accomplished, the angles forming the brackets were bolted tight and then welded in place before the load was released onto them. A deflection of 1/16 in. in the brackets was noted in most cases when the slings were removed. This was considered normal.

Window framing is of aluminum with two vertically pivoted sash in each frame. The frame is the same width as the panels. Vertical mullions of aluminum extend from the second floor to the roof, sealing the joints between panels and between window frames.

When completed in July 1960, the building will contain about 475,000 sq ft. This includes 18,000 sq ft of commercial area on the first and second floors and 75,000 sq ft of office space that will be rented on the upper floors. There will be a cafeteria designed to handle 2,000 people. Vertical transportation will be handled by seven self-service elevators and one freight elevator. The elevators will be supplemented by escalators for the first four floors. Heating will be handled by low-pressure boilers, and the air-conditioning system will have a capacity of about 1,500 tons.

For the bulkhead the consultants were Moran, Proctor, Mueser & Rutledge.

On the building, the architects are Kemp, Bunch & Jackson; the mechanical engineers, Van Wagenen, Taylor & Van Wagenen; the structural engineer, J. L. McCollough; the civil engineers, Robert M. Angas & Associates; and the general contractor, the Daniel Construction Co. of Florida.

Anchoring a tunnel in sand

GEORGE F. POLAND, Project Engineer

Thorington Construction Company, Richmond, Va.

While constructing a tunnel under New River at Ft. Lauderdale, Fla., the Thorington Construction Company of Richmond, Va., developed a method of anchoring a thin tremie seal for a construction cofferdam, that may open new vistas for work of this type. The New River Tunnel was a real challenge. Heavy reinforcing bars (No. 11, 1¼ in. in diameter, 1.56 sq in. in area) were grouted deeply into sand to take the hydrostatic uplift of more than 50 ft of water.

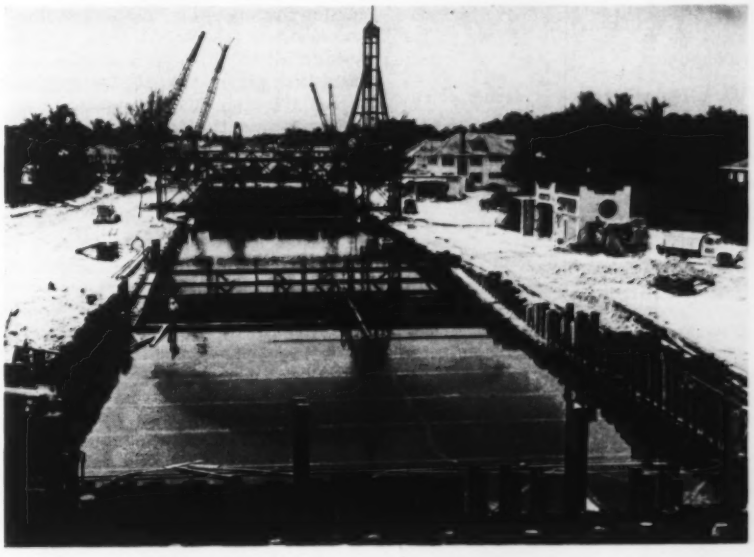
Florida might best be described as a strip of land 300 miles long, 100 miles wide and 2 ft thick; all the rest is water. The geology in the Fort Lauderdale area shows alternating layers of porous limestone and sand. Miami oolite of the Pleistocene epoch, a white-to-brown limestone riddled with solution holes, is the surface rock. Beneath it is a sand bed of variable thickness ranging from 1 to 20 ft thick. Below the sand layer comes another layer of porous limestone, which is hard on top and soft and shelly at the base, extending down 60 to 80 ft below the surface. The second limestone layer, like the first, is riddled with solution holes that have been filled with sand or marl or both. Below these three layers are alternating lenses of sand, marl, limestone, and sandstone nodules.

The New River Tunnel is on U.S. Route 1 in downtown Ft. Lauderdale. Heavy highway and river traffic have made a change from the existing bascule bridge necessary. The project is nearly half a mile long with grades of about 5½ percent down to an 850-ft tunnel section. Two roadways, each 24 ft wide, with 14-ft headroom, are provided as well as a sidewalk. River traffic had to be maintained during construction.

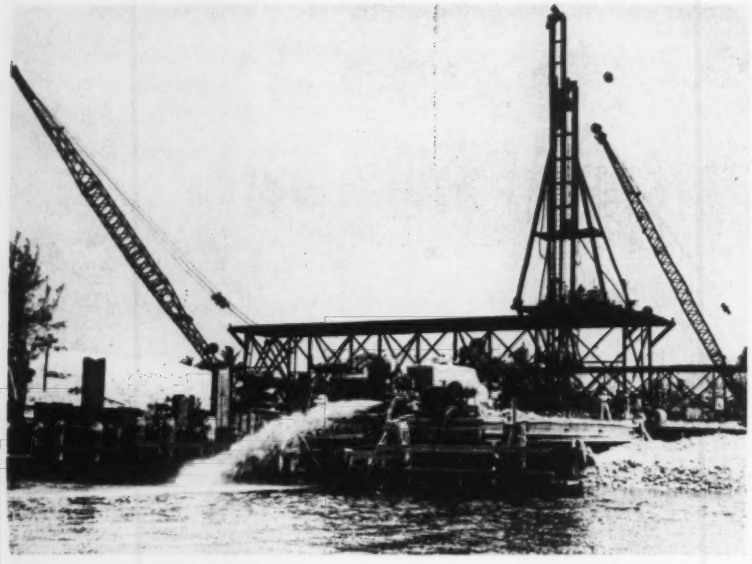
The tunnel was designed for two alternates. Alternate A called for dewatering by well points or a similar method. Alternate B called for a cofferdam method with an anchored tremie seal mat 4 ft thick. The project was awarded to Thorington at a bid price of about $6½ million. The mat anchorage was left for the contractor to design, subject to the approval of the engineer. Preliminary tests indicated the feasibility of inserting a No. 11 reinforcing bar into the underlying rock stratum for anchorage. A few bars were grouted 10 ft into the rock and subjected to a tensile load test. In all cases the bar failed in tension without being pulled out of the rock.

The contractor's design for a conventional single-wall cofferdam was approved. The first stage was 800 ft long and 77 to 85 ft wide. It was divided into two parts for easier dewatering. Depth at the land end varies from 8 to 43 ft and at the river end from 30 to 55 ft. Over 2,200 tons of MZ-38 sheet-piling were used, ranging in length from 20 to 70 ft. Bracing by wales and struts on 15-ft centers required over 1,300 tons of steel.

Anchoring of the tremie slab was sublet. The subcontractor designed a



Cofferdam of steel sheetpiling, rented from L. B. Foster Co., permitted excavation under water to level of tremie seal. Rig on traveling bridge in foreground installs the anchor bars. On the second bridge is a device for test pulling, used on a large number of the bars.



Tall leads on a moving frame were used to drive 7-in. casing for deep installation of uplift anchors.

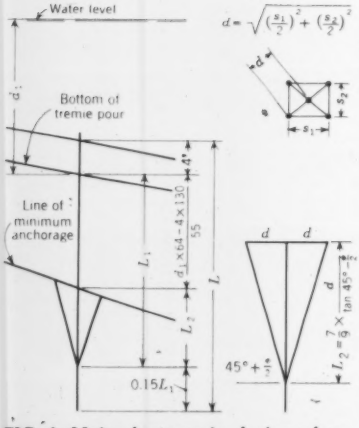
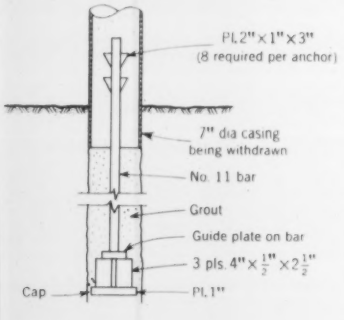


FIG. 1. Major features in design of anchors are illustrated.

FIG. 2. Anchor bar is set in a long column of grout and then casing is withdrawn so that the grout comes into contact with the surrounding sand.



system based on No. 11 reinforcing bars spaced at varying intervals depending on water uplift, which were to be grouted into the underlying rock. The bars were designed for a load of 46,800 lb at a stress of 30,000 psi in the steel and were to be subjected to a field test load of 65,000 lb.

Anchoring the tremie slab by the subcontractor got under way in the latter part of February 1959 when the excavation had been generally completed. A drilling bridge, which permitted the use of four machines at one time, was built by the general contractor for this operation. The subcontractor installed the No. 11 bars. A hole was drilled in the underlying rock and filled with grout; then the bar was inserted. The top of the bar was to be anchored into the tremie slab by the frustrum of a concrete cone 3 ft long that was 10 in. in diameter at the top and 4 in. at the bottom. The cone was cast in place using a high-strength grout.

Serious trouble was encountered when pull tests on the anchored rods were started. About 42 percent of the rods that had been installed failed to withstand the test load. The subcontractor had noticed, while drilling, that the rock layers were very discontinuous. Thus many of the anchors were not grouted into rock but were in sand. Accordingly this method of anchoring was rejected and the general contractor was required to provide a suitable system.

At the beginning of the project, consideration had been given to installing a 4-in. I-section with movable arms at the bottom to act somewhat like the flukes on a sea anchor. But field tests showed that it was economically unsound and physically impracticable. A gravity anchor based on the idea of a tension pile seemed to offer a solution.

It is the generally accepted view of the engineering profession that a friction pile distributes its load by a pressure bulb. It was deduced that if the action was reversed then the bottom of a pile would distribute the load through the soil by a similar pressure bulb. This pressure bulb, for a single pile, would move against the weight of the earth confined in the bulb if the pile were properly grouted into the soil. To simplify computations, a bulb of conical shape was assumed.

Another important factor in the development of the anchorage was the number of units to be considered. As in the case of a pile group that is used under a foundation, the group acts differently from a single pile because of the overlapping of the pressure bulbs. Similarly, an individual anchorage would have a conical shape only until it met with the influence cones of adjacent units. Thus a plane parallel to the bottom of the anchors would be created. The weight of the soil above the plane would serve to overcome the buoyant forces acting on the bottom of the tremie seal.

Since the Thorington Construction Company is primarily interested in construction and its management, Dr. Erdam Ardaman of the Outlaw Laboratories in Orlando, Fla., was retained to check the assumptions, and after a series of laboratory experiments he agreed with the general conclusions. He refined the cone-shaped pressure bulb to one with a parabolic distribution that would contain more soil than the conical bulb. Since this was the first time that the idea of such an anchor unit had been developed in practice, so far as could be determined, the conical idea was used for simplification.

The design of the anchor was based on the resultant forces at the bottom of the tremie slab. At a particular station the depth was calculated. The depth multiplied by 64 lb per cu ft gave the uplift force per square foot at the bottom of the slab. Since the concrete in the 4-ft-thick tremie slab weighed 130 lb per cu ft, 520 psf could be subtracted from the buoyant force to give the unbalanced uplift.

To counteract this unbalanced uplift, the underlying soil was assumed to be sand. Any rock present would give an additional factor of safety. The

weight of sand in water was taken as 55 lb per cu ft, which is believed to be on the conservative side. The unbalanced force at the base of the tremie was divided by the weight of the sand to find the depth of soil required to counterbalance the remaining uplift. This depth was called the line of minimum anchorage (Fig. 1). Below this depth the value of the cone was developed.

The central angle of the cone was taken as 90 deg—Ø, where Ø is the angle of internal friction. The base of the cone was twice the square root of spacings, transverse and longitudinal, of the adjacent anchors. Since the application was rather novel, a factor of 15 percent was added to the length of the cone and the depth of the minimum anchorage to obtain the engineer's approval. Thus, at any location along the sloping tunnel excavation line, the length of the anchor could be calculated. The spacing in either direction was such that the unbalanced uplift times the area covered by one anchor did not exceed 46,800 lb.

The anchor consisted of three major parts: (1) a core rod which was a No. 11 reinforcing bar, and since the bars were purchased in 40-ft lengths, they had to be butt welded to get the length required; (2) a grout cylinder around the core rod; and (3) anchor clips in the tremie slab at the top of the anchor pile. To the top part of the anchor, eight clips were welded to transmit the load from the tremie to the anchor pile. The grout cylinder around the anchor unit transmits the load of the anchor to the surrounding soil.

The installation of the anchors became a matter of routine with the use of several pieces of equipment. A trussed bridge was constructed to span the width of the cofferdam. The bridge, which was mounted on wheels so as to roll longitudinally along the cofferdam, carried a set of movable leads that could be shifted across the width of the cofferdam. Conventional grouting equipment, mixing tubs and a piston-type pump were employed.

An oil-well casing of 7-in. diameter, was first driven to the computed depth by a McKieran-Terry 9B3 hammer, operated by a 600-cfm compressor. The casing was long enough to extend from the bottom of the trussed bridge to the required depth of the anchor. At the deepest point in the cofferdam, the casing was 130 ft long and the anchor 72 ft to extend into the tremie seal. To keep sand out of the casing during driving, an expendable cap was placed on the bottom of the casing. Two wires clipped to the bottom of the casing kept the cap in place during driving. When the casing was extracted, the weight of the grout column forced the cap off.

After the casing had been driven to the predetermined depth, a grout "needle" was lowered to the bottom to make sure that the casing had not become plugged with sand. Grout was then pumped into the casing, displacing any water that might have seeped in. After the grout had been pumped in, the anchor rod was placed in the casing and allowed to drop to position. Another check was made with the grout pipe to insure that the anchor did not "hang up" in the casing. The casing was then slowly extracted allowing the grout to completely fill the hole in the sand around the anchor rod.

By this method over 2,000 anchors with a total length of 113,000 ft were placed in three months. The anchors were tested to an uplift of 65,000 lb until a pattern of reliability was established. Under this system only nine anchors failed to meet the test and had to be replaced. Most of the failures were in the butt welds of the anchor rods.

The big test came with the dewatering of the cofferdam sections. The success of the anchorage system was proved when the shallower land section was dewatered. Additional proof of dependability came with the dewatering of the river part. It is believed that this basic idea can be improved upon and can lead to more economical deep cofferdams.

The New River Tunnel was designed by Singstad & Baillie for the Florida State Road Department. It is being constructed by the Thorington Construction Co. of Richmond, Va. James E. Hood, M. ASCE, is the project manager and Harold Guppy the field superintendent. The writer, who is the project engineer for the contractor, was in charge of the design of the anchorage system. E. V. Jones, F. ASCE, is the resident engineer for Singstad & Baillie on the tunnel, while John M. Gerren, Jr., represents the State Road Department on the project.

ORIGINALITY NEEDED IN RESEARCH

Scientific and technological advance could be speeded in the United States, if our research and development were conducted under conditions more conducive to originality. This is the consensus of 51 of the nation's top scientists, researchers, and educators, who conferred for two days this winter at Worcester Polytechnic Institute under the auspices of the National Science Foundation in cooperation with fifteen leading scientific and engineering societies. ASCE was represented at the conference by Dr. Arthur T. Ippen, chairman of the Society's Research Committee, and Dr. Martin A. Mason, past chairman of the Research Committee.

The group thought that researchers too easily become preoccupied with goals of relatively small dimension which promise little in significant discovery, and that for breakthroughs on the frontiers of science we are far more dependent "on those who can strike out with vigor and vitality." They felt that the young researcher is steered in too conservative a direction by his education, research support, and professional societies as well as by his social and cultural environment.

These tendencies, they said, serve to advance the extension of knowledge in small steps. More rapid and efficient progress, they felt, might reasonably be expected if greater encouragement were given young people to "leapfrog for the distant goals." To this end, a conference resolutions committee recommended that colleges and universities:

1. Develop educational programs that require the student, from the outset of his education, to exercise a high degree of originality and independence of thought.
2. Bring talented youth into stimulating personal association with leading scientists and engineers.
3. Encourage more venturesome attitudes in doctoral research.
4. Develop institutional policies that provide an encouraging environment for venturesome research. (This starts with creative faculty members.)
5. Develop closer liaison between college, industrial, and governmental research organizations.
6. Encourage undergraduate and graduate students who have novel, creative ideas to pursue the development of these ideas and help them to obtain financial support.

(Continued from page 41)

EJC Progress Reported by President Needles

Progress made by Engineers Joint Council in 1959 and its prospects for the future were the dominant themes of retiring EJC President Enoch R. Needles' report to the organization's annual meeting, held in New York City on January 22. Mr. Needles, a Past President of ASCE and prominent consulting engineer, looks to the future of EJC with "very great enthusiasm."

"EJC is forging ahead," Mr. Needles told the group. "It has established its position as the common meeting place for consideration, discussion, and action on the common problems of our Societies. . . . It is a democratic assembly of twenty-one different organizations, each successful and functioning in its own right, just as our nation is a union of fifty separate and mutually respecting states. Our national strength lies in the complete cooperation of these states on major problems of national and common interest. No one state takes precedence over or dominates the others. I cannot question for a moment the fact that we have now a sound and true basic unity in our profession, and it is strengthening by the day. It is not possible to attend the board and committee meetings of Engineers Joint Council and hear the discussions, reports, and proposals, and to observe the devotion of our Society representatives and their actions, without reaching the conclusion that we *do* have a cooperative agency or Council through which our Societies hold common meetings for common action on common problems for the benefit of our Societies and our profession. Engineers Joint Council is of continually expanding importance, and we owe a tremendous debt of gratitude to those determined and consecrated pioneers who made possible this Council of today.

"Engineers Council for Professional Development, United Engineering Trustees, and Engineers Joint Council are factual, permanent, and indispensable as cooperative endeavors of our major engineering Societies. They will endure, because their principles are sound and basic. The needs they fill are real, and all have magnitude and strength beyond the means of any temporary or individual force to weaken or divert from their true functions of broad service to our profession. The United Engineering Center, now under construction, will become another symbol of cooperation and advancement within our profession. The modern engineering curricula, processed and refined during the past twenty-five years through ECPD, constitute a similar idealistic symbol.

"Just where does Engineers Joint Council stand at the present time? With all eyes turned so directly toward Washington today, I believe it is important that we check our position there. EJC has entree and status on Capitol Hill, both in the Senate and the House of Representatives. Its position is the same in the Executive Offices of the White House, and in a number of the Departments, such as Commerce, and in such places as the Office of the Chief of Engineers. Virtually all the doors in Washington are open to those of us who approach them on behalf of EJC. It is very significant that your incoming president [Augustus B. Kinzel] has been elected chairman of the Division of Engineering and Industrial Research of the National Academy of Sciences. This is important evidence of the newer and stronger ties between engineering and science and the leaders in these fields at the national level.

"Engineers Joint Council has official representation in UNESCO, the United Nations Educational, Scientific and Cultural Organization. We can take great satisfaction in the designation of our representative to head up an important recent summer conference on South American affairs, related to the effective work of the engineers and the scientists in driving forward towards world peace. We appear to be only on the threshold in making our contributions to the vital program for peace. . . . Engineers of all races appear to have common thoughts, analytical procedures, and means of understanding each other that are quite fully divorced from politics and propaganda.

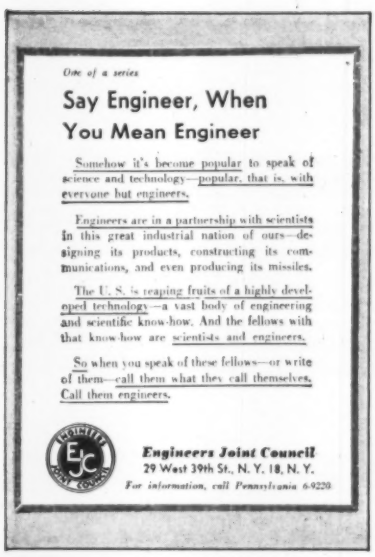
"We have a very strong and growing relationship with the National Science Foundation. EJC has continually sought to be helpful to NSF, and NSF is finding new ways in which to utilize EJC . . . NSF has now entered into a contract with EJC to explore the possibilities of developing a new and complete National Engineers Register. This initial study is proceeding under the chairmanship of Dr. Harold Osborne. The staff on this project is working under an appropriation of $34,000. The next several months will tell what the register should be, how it will be developed, and how it may best be utilized. The development of the register itself may well involve two years of work and an outlay approaching $1,000,000, but the many benefits to come from the register will justify the endeavor.

"It is appropriate to report that IAESTE, the International Association for the Exchange of Students for Technical Experience, is now administered through EJC and with the staff set up within EJC. This very worthy program gives promise of assured development and expansion. Again, throughout the international area, the engineer and engineering education must certainly do their parts steadily and forcefully for world peace.

"It is important to report that our National Transportation Policy Panel is now officially in existence, and formal notification of this fact has gone to appropriate agencies in Washington. This panel consists of twenty-one engineers who are specialists from the major divisions of transportation represented by rail, highway, air, water, and pipeline. They are available to serve our governmental agencies, upon invitation, in all phases of engineering involved in transportation.

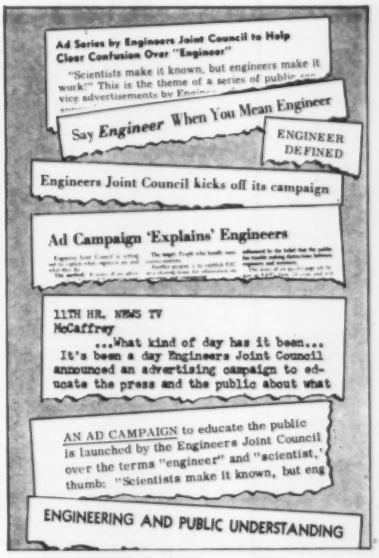
"There has been remarkable growth in the past five years in the adaptation of electronic computers to problem solving and data processing in the different fields of engineering. This has to do with the users of the machines rather than the designers and manufacturers. Surprisingly popular conferences have recently been held by some of the major technical societies, with programs directed toward data processing as involved in traffic analysis and earthwork computations, and toward problem solving as required in stress analysis and structural and machine design. . . . As the result of the recent Eastern Joint Computer Conference in Boston, sponsored by the Chemical Engineers, it has been suggested to the Civil Engineers that there should be an interchange of computer information among the engineers of the different major Societies and that the leadership should be headed up in Engineers Joint Council. . . .

(Continued on page 78)


One of a series
Say Engineer, When You Mean Engineer
Somehow it's become popular to speak of science and technology—popular, that is, with everyone but engineers.
Engineers are in a partnership with scientists in this great industrial nation of ours—designing its products, constructing its communications, and even producing its missiles.
The U. S. is reaping fruits of a highly developed technology—a vast body of engineering and scientific know-how. And the fellows with that know-how are scientists and engineers.
So when you speak of these fellows—or write of them—call them what they call themselves. Call them engineers.
Engineers Joint Council
29 West 39th St., N. Y. 18, N. Y.
For information, call Pennsylvania 6-9220

One of a series
Just Who's Firing Those Missiles?
From the news stories you might think that Cape Canaveral is populated only by scientists and electronic brains. As a matter of fact, much of the design, construction and operation of our missiles and satellites is the work of engineers. Engineers don't want to take credit from the scientists, upon whose original research the missile program is based, but they do feel that the public should recognize engineering as a major force in the missile program.
Engineers Joint Council has been established by the engineering profession of the United States, to help you make the public properly aware of what the engineers are doing. For facts about engineers and the engineering profession, check with—
Engineers Joint Council
29 West 39th St., N. Y. 18, N. Y.
For information, call Pennsylvania 6-9220

Six small advertisements like these . . .


Ad Series by Engineers Joint Council to Help Clear Confusion Over "Engineer"
Say Engineer When You Mean Engineer
ENGINEER DEFINED
Engineers Joint Council kicks off its campaign
Ad Campaign 'Explains' Engineers
11TH HR. NEWS TV
McCaffrey
...What kind of day has it been... It's been a day Engineers Joint Council announced an advertising campaign to educate the press and the public about what
AN AD CAMPAIGN to educate the public is launched by the Engineers Joint Council over the terms "engineer" and "scientist," thumb: "Scientists make it known, but eng
ENGINEERING AND PUBLIC UNDERSTANDING

Had this kind of impact.

EJC Ads Aim at Press; Hit Wide Public

In its effort to reach the men who write the news—to tell them some things about engineers—Engineers Joint Council has done even more. Its ad campaign has been brought to the attention of the general public, cited by radio and television newscasters.

At the end of 1959 all six ads in the EJC campaign had run in Editor & Publisher, business magazine of the nation's newsmen. Purpose of the advertisements: to make those who communicate the news more aware of what engineers are and what engineers do.

One object was to help the journalists distinguish between engineers and scientists. Another object was to establish EJC in their minds as the voice of the engineer, prime source of information for them on stories about engineers and engineering.

TV and radio newscasters told audiences of millions that EJC had launched an educational campaign with the theme: "Scientists make it known; engineers make it work."

As the general public got this word of the ad campaign, releases went out to others. Effectiveness of the modest expenditure on advertising space was multiplied as society journals and business papers read by engineers found the ad campaign newsworthy.

Resulting pieces of publicity given the campaign—the radio, TV, magazine and newspaper mentions—can't be assigned a dollar value. But it would be considerable.

Headlines read:

"Ad Series by EJC to Help Clear Confusion Over 'Engineer'"

"Engineers Joint Council Kicks Off Campaign to Recast Your Image"

And the mail came into EJC headquarters:

". . . It is hoped the ads will help news writers and editors to present a better picture of the engineer and what he does."

"Every engineer should become a missionary on this theme."

This modest ad program was done with voluntary contributions from several of the societies within EJC. The Council's 1959 Public Relations budget (about ¼ cent per engineer as opposed to $6.50 per member spent yearly by the American Medical Association) had no money for it. However, the sentiment was there; EJC Secretary E. Paul Lange had ample response to the request for voluntary funds.

The advertising campaign was but one of recent services performed on behalf of the engineering profession by Engineers Joint Council. EJC operates continuous programs and conducts regular surveys of use to the profession, to government and to industry:

- EJC's Manpower Commission compiles and distributes information on the demand for engineers; it also surveys their salaries.
- EJC is the U. S. representative for Iaeste (international student exchange) and conducts a foreign visiting engineering teacher exchange.
- EJC coordinates the National Nuclear Congress.
- It also is responsible for publishing the Engineering Societies Register and plans a National Engineers Register.

Engineers Joint Council is a federation of engineering societies with a total membership of over 300,000.

Its constituent societies are: American Society of Civil Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; American Society of Mechanical Engineers; American Water Works Association; American Institute of Electrical Engineers; American Society for Engineering Education; American Society of Heating, Refrigerating and Air-Conditioning Engineers; American Institute of Chemical Engineers; Society of American Military Engineers; American Institute of Industrial Engineers.

Its associate societies are: American Society of Agricultural Engineers; American Institute of Consulting Engineers; American Institute of Plant Engineers.

And its affiliate societies: Western Society of Engineers; Louisiana Engineering Society; North Carolina Society of Engineers; Engineering Societies of New England; South Carolina Society of Engineers; Los Angeles Council of Engineering Societies; Kentucky Society of Professional Engineers; Consulting Engineers Council.

(More ASCE News on page 78)

A crawler-mounted slip-form paves the San Diego Aqueduct

ROBERT B. DIEMER, F. ASCE, General Manager and Chief Engineer
Metropolitan Water District of Southern California, Los Angeles

Thirsty San Diego County, California, will soon be receiving additional Colorado River water through the Second San Diego Aqueduct. Winding its way southward 91 miles from its junction with the Metropolitan Water District's Colorado River Aqueduct (see map, Fig. 1), the Second Aqueduct will provide a much needed supplement to the first. The first aqueduct was completed by the U.S. Navy in 1947 as an emergency war project and enlarged by the Bureau of Reclamation with a second pipeline completed in 1954. Total designed capacity of both sections of the first aqueduct is 165 cfs delivered to San Vicente Reservoir; the combined delivery is about 20 percent greater than this at present.

The Second Aqueduct has a capacity of 1,000 cfs in open canal between its turnout from the Colorado River Aqueduct and Auld Valley, a distance of 15 miles. From Auld Valley to its terminus at Lower Otay Reservoir, the aqueduct is in a covered pipeline and has a capacity diminishing from 250 to 144 cfs. The Metropolitan Water District of Southern California is building the upper portion from its junction with the Colorado River Aqueduct to a point 6 miles south of the San Diego County Line. The San Diego County Water Authority is handling construction from this point southward to the terminal reservoir.

Included in the Metropolitan Water District's section of the aqueduct is a total of 19.6 miles of open canal. Of this, 15 miles are part of the Second San Diego Aqueduct with a trapezoidal cross section and side slope of 1 vertical on 1½ horizontal, a 12.0-ft bottom width, and a depth of 11.5 ft. Upstream from the junction of the two aqueducts, about 1.6 miles of similar canal serves as the second conduit in the Casa Loma Siphon of the Colorado River Aqueduct. Then, to complete the second conduit of the Casa Loma Siphon, a 3.0-mile length of canal on steeper grade, with a 12.0-ft bottom width and an 8.5-ft depth, extends from the junction to the downstream end of the siphon on the Colorado River Aqueduct. All the canal sections were designed with a 4-in. unreinforced concrete lining with weakened plane control joints at about 12 ft on centers each way.

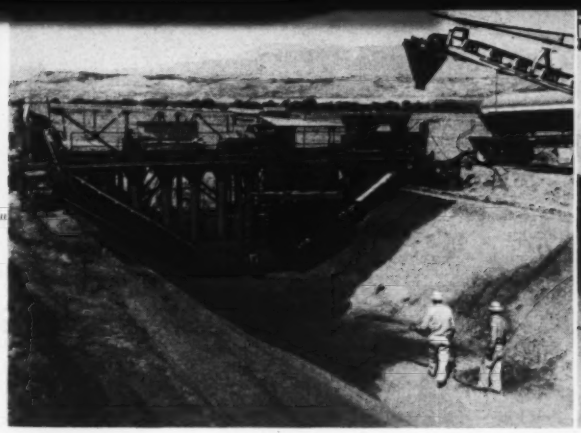
One of the outstanding features in the construction of the Second Aqueduct, now nearing completion, is the slip-form operation used in lining the open canal sections. In concrete canal lining, as in other fields of construction, mechanization has been the key to progress. The first slip-form pavers were developed for use in canal construction during the 1930's. Since then, evolutionary improvements have been made on almost every job. The second San Diego Aqueduct is a good example of such progress.

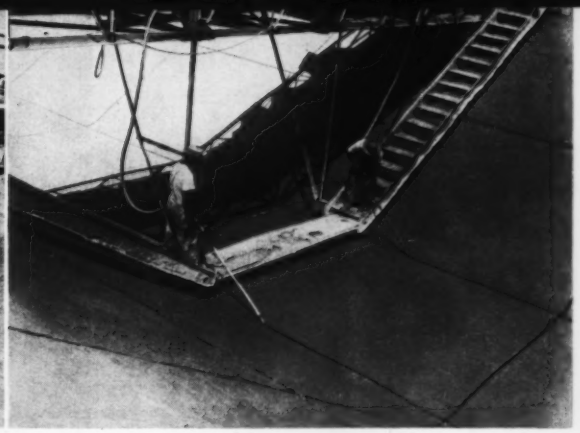
The earliest canal pavers were rail mounted. Grade control was maintained by hydraulic jacks set at each corner of the machine. The jacks were activated manually by a man on each side of the machine who observed the position of indicator arms relative to a taut grade wire. This system was later improved by wiring the indicator arms to operate lights at a central control station where one man could operate all four jacks with a four-bank hydraulic valve. The indicator arms were moved up or down by contact with the grade wire. From this system full automatic grade control evolved. On the modern slip-form canal paver, the indicator arms, pivoting about their horizontal axes, contact limit switches. The limit switches, in turn, operate solenoid valves to control the movement of the hydraulic jacks to within ⅛ in.

Still another major improvement has been added in the Guntert-Zimmerman paver used on the San Diego Aqueduct canal. Crawler mounting has been substituted for rails. The elimination of rails has greatly simplified construction and has provided operating flexibility. Grade control on the crawler-mounted slip-form is maintained just as has been described—by solenoid activated jacks. Alignment control is accomplished by setting the grade wire on one side of the canal to the true alignment. An alignment indicator mounted on the side of the machine is rotated by contact with the wire whenever the paver begins to veer off from the true alignment. This again operates limit switches that regulate the speed of the separate crawler motors and bring the paver back immediately into true alignment. Variable-speed crawler motors also facilitate operation of the machine on curved sections of canal.

The concrete is mixed in a dual-drum paving mixer from dry batches of 1⅓ cu yd delivered by truck. Concrete is transferred by a belt conveyor to a traveling hopper, which distributes it to a series of tremie hoppers across

FIG. 1. San Diego Adqueduct.





Dual-drum paving mixer, above, with belt substituted for bucket, delivers concrete to traveling hopper that feeds tremie pipes on canal paver. Above right, joints are formed by canal paver and promptly filled from traveling bridge.

the width of the slip-form paver. (See photo.) The paver is made up of a 48-in. pan slip-form followed by a 24-in. spring-loaded float pan. A continuous vibrator is mounted parallel to and just ahead of the leading edge of the slip-form pan. Concrete dropping through the tremie tubes is thus thoroughly compacted in place. Output, using a dual-drum mixer operating from each berm, has reached 1,224 lin ft in an 8-hour day. This represents a placement rate of about 100 cu yd per hour.

Contraction-joint grooves, as mentioned above, are required at a spacing of 12 ft on centers each way. Longitudinal grooves are formed by groovers fastened to the trailing edge of the slip-form and the float pan. Transverse joints are formed by a cutting bar forced into the concrete by four hydraulic rams. To control the transverse-joint spacing, a wheel, 12 ft in circumference, which is mounted in front of the machine, lights an indicator each time it makes a complete revolution. The paver operator then manually activates the cutting bar.

All joints are tooled by finishers working from a jumbo which operates immediately behind the paving machine. Following the finishing jumbo is a second jumbo from which curing compound and joint sealer are applied. The joint sealing material is Hunt's cold-applied, internal set-up joint mastic. It is mixed in a pug mill carried on the jumbo. A white pigmented curing compound is sprayed on. The electric power required to operate the trailing jumbos is taken direct from the paving machine.

Trimmer for fine grading

Another interesting feature of the project is the trimmer used for fine grading. This trimmer, like the slip-form paver, is mounted on crawlers. Both grade and alignment control are maintained for the trimmer as described for the paver. Rough excavation, to within one foot of final grade, is done by dragline or carrying scraper. The canal trimmer follows, and trimming is accomplished in most cases with two passes, by means of traveling conveyor buckets. The excavated material is deposited from the buckets onto a conveyor belt, which carries it to the top of the canal berm.

Movement of the trimming and paving equipment around such obstacles as bridges, overchutes and siphons is easily accomplished by a very novel method of lifting with two side-boom tractors, one on each side of the machine.

Now that the State of California's Department of Water Resources is planning to embark on construction of its multi-billion dollar Feather River and Delta Diversion Projects, advances in construction techniques made on the San Diego Aqueduct are sure to play an important future role.

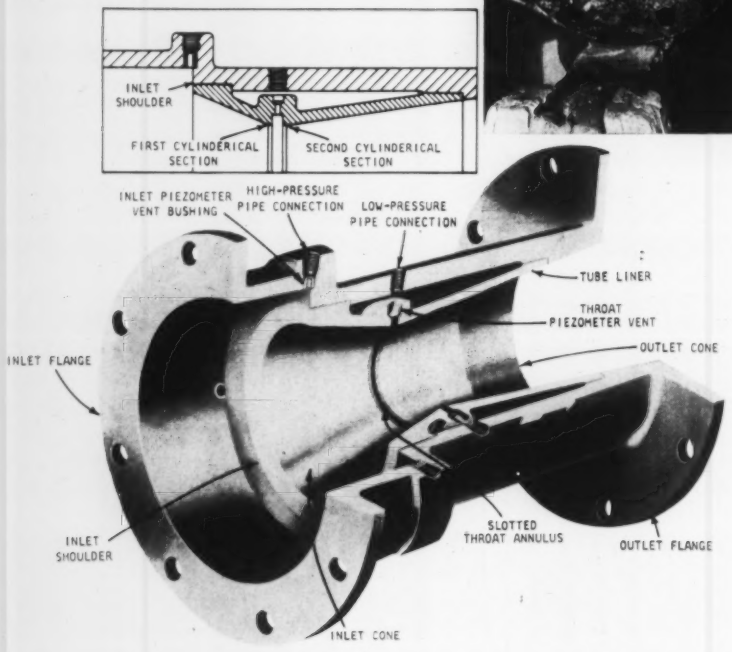
The contract for construction of the aqueduct here described is held by Winston Bros. Company with L. D. Adams as project manager. Robert A. Skinner, F. ASCE, Assistant Chief Engineer, was in charge of design for the Metropolitan Water District, and H. J. Mills, M.ASCE, is in charge of construction.

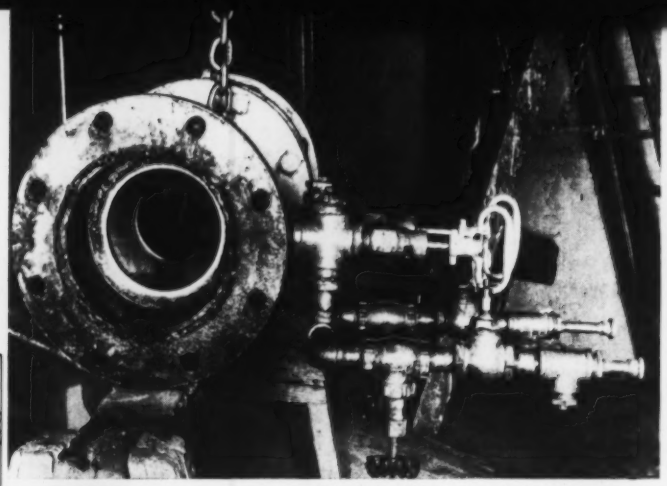
Construction of the project was commenced in November 1958 with R. B. Ward, M. ASCE, as resident engineer. Upon his death on April 27, 1959, Mr. Ward was succeeded by W. S. Merrithew, M. ASCE.

Canal trimming machine cuts to accurate line and grade. Belt conveyor disposes of material. Trimming machine is mounted on crawlers.

Section of canal is seen after the trimming machine has passed.

FIG. 1. Typical Dall flow tube





This 8-in. Dall flow tube was photographed after four years of service in metering activated sludge.

THE DALL FLOW TUBE

EDMOND B. LYNCH, Product Specialist (Flow Meters), B-I-F Industries, Inc., Providence, R. I.

Despite apparent violation of all accepted rules of good hydraulic design, the Dall flow tube for measuring fluid flow has excellent hydraulic characteristics and a wide field of application. This remarkable primary differential or flow-measuring device was developed by H. E. Dall in England. It has been manufactured in this country since 1954. The hydraulic properties of the new instrument and successful field installations are outlined here.

In the Dall flow tube two short truncated cones are separated by two very short cylindrical sections with a slot between them. The fluid enters the device past a sharp-edged reduction called an inlet shoulder or dam. Just upstream from this shoulder is the high-pressure connection. The fluid flows through the inlet cone, across the first cylindrical section, and over the throat slot. See Fig. 1. The low-pressure connection is at this slot. After crossing the slot, the fluid passes the second short cylindrical section, passes through the truncated outlet cone, and past a sharp-edged enlargement to return to the original diameter of the pipeline. Each change in cross section is very abrupt, and the recovery cone is very short, having an included angle of about 15 deg. The entire device is also short, being about one to two pipe diameters long, depending on throat size. The smaller the throat, the longer the tube.

Discharge coefficient

One important hydraulic characteristic of any flow measuring device is the constancy of its discharge coefficient over wide ranges of flow. This is important for it is through this coefficient that head differential readings are converted to flow data.

The significant formulas are:

$$Q = KC_d AV \quad \ldots\ldots\ldots\ldots (1)$$

where Q is the discharge, K an approach velocity constant, C_d the discharge coefficient, A the area, and V the velocity.

$$V = \sqrt{2gh} \quad \ldots\ldots\ldots\ldots (2)$$

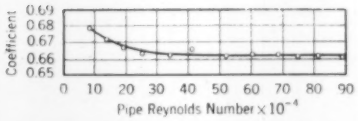


FIG. 2. In calibration of 8.00-in. x 5.85-in. Dall flow tube, discharge coefficient is plotted against pipe Reynolds number.

where V is the velocity, g the gravity constant, and h the head differential. Combining these gives

$$Q = KC_d A \sqrt{2gh}$$

Thus it is seen that if the discharge coefficient is a constant, Q is proportional to $\sqrt{h}$. A typical plot of the discharge coefficient versus the pipe Reynolds number for a Dall flow tube is given by I. O. Miner and shown in Fig. 2. This plot is for an 8.00-in. x 5.85-in. Dall flow tube and the coefficient of discharge does change for different diameter ratios, that is,

$$\beta = \frac{\text{Throat diameter}}{\text{Upstream diameter}}$$

as shown in Fig. 3. However, any particular Dall flow tube will yield a graph similar in shape to Fig. 2. Therefore the coefficient of discharge may be taken as constant for any Reynolds number greater than 350,000. For applications involving lower Reynolds numbers, the secondary instrument can be characterized to account for any coefficient change.

Accuracy

When a new measuring device is developed for primary flow, its accuracy is of great interest. Such a device must be able to correctly measure the flow passing through it, to a close tolerance, over a wide range of flows. Use of the term "tolerance" to define the accuracy of a flow meter has been suggested. Tolerance is defined as twice the standard deviation of the variation of the measured flow from the actual flow. Statistics indicate that 95 percent of the values of measured flows will fall within twice, plus or minus, the standard deviation from the actual flow. The tolerance value, therefore, takes in 95 percent of the errors inherent in the device.

Thirty-two different sizes of Dall flow tubes were tested at flows with Reynolds numbers above 350,000 and the tolerance value determined as plus or minus 0.962 percent. This means that 95 percent of the flows measured by the tube will be within 1 percent of the actual value. The actual data points in Fig. 3 indicate the accuracy of the device.

To prevent any inaccuracies in metering, it is essential that the fluid entering a tube be of uniform turbulence, free from helical flow and from local high- or low-pressure areas. Such irregularities do not exist in long uninterrupted runs of straight pipe.

Sometimes such ideal conditions cannot be achieved, particularly where pumps, elbows, valves or other fittings must be installed close to the inlet of the tube. The effect of such features must be considered, and the error due to them can be reduced considerably by the installation of a straightening vane assembly.

One elbow upstream. A single elbow installed upstream from a Dall flow tube will cause an inaccurate reading. The amount of error introduced depends on the diameter ratio of the tube and the amount of straight pipe between the elbow and the tube. The curves of Fig. 4 show the number of diameters of straight pipe required between the elbow and the tube inlet to reduce the error to one half of 1 percent (Curve A); to less than 1 percent (Curve B); or to less than 2 percent (Curve C).

Two elbows in the same plane upstream. Unless other flow disturbing factors are present, the length of straight pipe required between the tube and two elbows in the same plane upstream is approximately the same as for a single elbow upstream.

Two elbows not in the same plane upstream. This condition causes helical flow and inaccurate meter readings. Straightening vanes are recommended for it, except where an exceptionally long run of straight pipe can be provided between the elbows and the tube inlet.

Decrease in upstream pipe diameter. Upstream piping smaller in diameter than the inlet of the tube will cause a low meter reading. The deviation increases with the diameter ratio of the tube, but even when the pipe diameter is reduced by 5 percent, the change in coefficient is less than 2 percent at the maximum permissible tube diameter ratio.

Valves. Since valves in upstream piping seriously affect the metering accuracy of Dall flow tubes, such valves should be located in downstream piping wherever possible. Gate valves or butterfly valves may be installed in upstream piping if they are to remain fully open during metering.

Increaser upstream. A pipeline increaser upstream from a Dall flow tube will cause the meter to read low. The amount of change depends on the ratio of diameters of the increaser, closeness to the tube, and the diameter ratio of the tube. In Fig. 5 is shown the num-

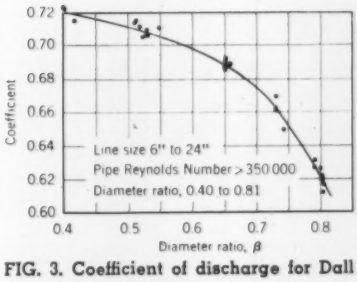


FIG. 3. Coefficient of discharge for Dall flow tube is plotted against diameter ratio. Note that actual data points from 32 tests are very close to the curve.

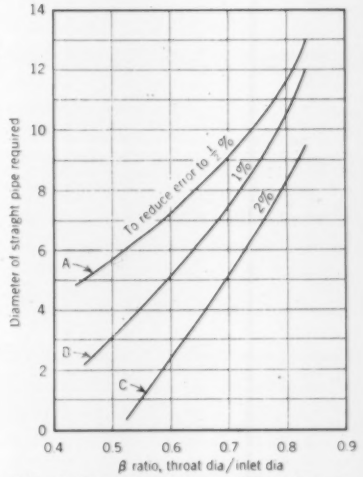


FIG. 4. Diameters of straight pipe required following short-radius elbow and preceding inlet of Dall tube to reduce error to percentages shown.

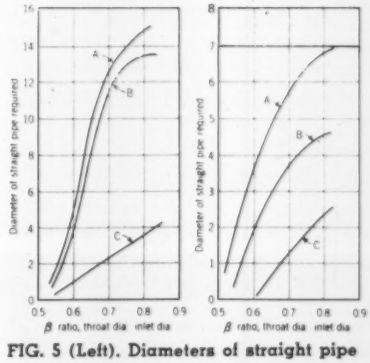


FIG. 5 (Left). Diameters of straight pipe required between a pipeline increaser (0.75 ratio) and tube inlet to reduce deviation to ½ of 1 percent (Curve A), to less than 1 percent (Curve B), or to less than 2 percent (Curve C).

FIG. 6 (Right). Diameters of straight pipe required between a pipeline decreaser (0.8 ratio) and tube inlet to reduce deviation to ½ of 1 percent (Curve A), to less than 1 percent (Curve B), or to less than 2 percent (Curve C).

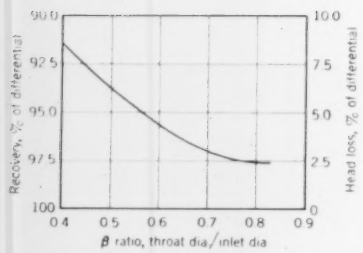


FIG. 7. Recovery characteristics of Dall flow tube. Ratio of throat diameter to inlet diameter is plotted against recovery or head loss in percentage of differential.

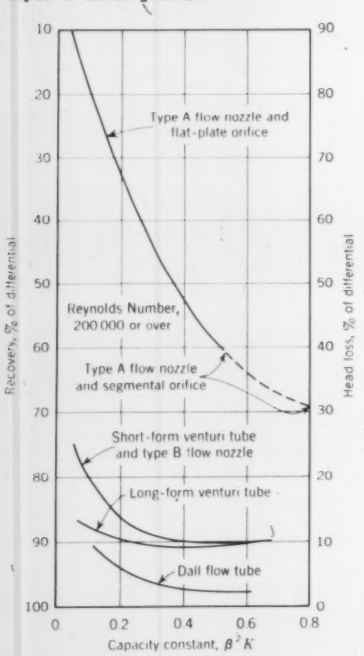
ber of diameters of straight pipe required between a pipeline increaser having a 0.75 ratio between upstream and downstream diameters and the tube inlet to reduce the deviation as follows: to one half of 1 percent (Curve *A*), to less than 1 percent (Curve *B*), or to less than 2 percent (Curve *C*).

Decreaser upstream. A pipeline decreaser upstream from a Dall flow tube will cause the meter to read high. The amount of the change depends on the ratio of diameters of the decreaser, closeness to the tube, and the diameter ratio of the tube. In Fig. 6 is shown the number of diameters of straight pipe required between a pipeline decreaser having a 0.8 ratio between downstream and upstream diameters and the tube inlet to reduce the deviation as follows: to one half of 1 percent (Curve *A*), to less than 1 percent (Curve *B*), or to less than 2 percent (Curve *C*).

In many cases where there is an inadequate straight run of piping upstream, the meter run can be simulated in a hydraulics laboratory and the coefficient determined. For line sizes over 24 in., it is not economical to test the primary meter, so frequently model tests are used and the laws of hydraulic similitude applied.

Downstream piping. Conditions downstream from the Dall flow tube have practically no effect on its discharge coefficient and a valve, elbow, or other fitting may be installed at the outlet, if desired. Where the downstream piping is to be of a different size from that upstream, an increaser or decreaser may be attached directly to the outlet flange.

FIG. 8. Recovery characteristics of differential producers at equivalent capacity. Type A flow nozzle has no recovery cone (ASME type and ISA type). Type B flow nozzle has a recovery cone with a taper of 4:1 or greater.


Type A flow nozzle and flat-plate orifice
Reynolds Number, 200 000 or over
Type A flow nozzle and segmental orifice
Short-form venturi tube and type B flow nozzle
Long-form venturi tube
Dall flow tube
Recovery, % of differential
Head loss, % of differential
Capacity constant, $\beta^2 K$

Head loss

An examination of the flow tube construction might logically lead to the conclusion that it would have poor hydraulic properties with respect to head loss. This is due to the presence of many sharp corners and the lack of graceful curves. Surprisingly enough, just the opposite is true. The head-loss characteristics are excellent, the differential created is high, the recovery of pressure is high and the permanent head loss is lower than that of any other standard differential producer.

The percentage of the differential produced, which is recovered or lost for various diameter ratios, is shown in Fig. 7. The permanent head loss was determined by measuring the pressure drop between taps—one diameter upstream and five diameters downstream. The friction loss in six diameters of pipe was subtracted from the pressure drop reading. In Fig. 8 is given a comparison of differential recoveries among standard devices. To obtain a fair comparison of the losses caused by various differential producers, it is necessary to compare sizes which produce the same differential pressure for the same rate of flow. This has been done in the preparation of Fig. 8. The head loss in the Dall tube is significantly lower than that in the other devices, in spite of its short length and angular construction.

The Dall flow tube is available in conventional cast iron with a throat of bronze or stainless steel. In smaller sizes it may be made of aluminum, monel or several other materials. There are models designed for use with flanged or welded steel pipe and for reinforced and prestressed concrete pipe. Plastic inserts can be used for corrosive liquids. This versatility has widened the usefulness of the device.

Field installations

Water. The primary early application of the tube was in metering water, both in municipal and industrial plants. Two 72-in. meters, the largest in America, are at present metering raw water at the Savannah River Project in Georgia.

A 36-in. and an 18-in. plastic-insert Dall tube were installed in the Southwest by a leading oil company for metering highly corrosive water used to recharge oil wells. These tubes are constructed of epoxy plastic cones, reinforced with a fiberglass mat and stainless-steel throat and holding ring. A substantial saving was realized with this type of construction because the aggressiveness of the water necessitated either all stainless steel, or some other material equally resistant to corrosion, in this case the epoxy plastic. The Dall flow tube has successfully metered sea water in many installations.

Gases. A 60-in. tube is currently metering air for the activated sludge units of the South Chicago Sanitary District Plant. Good head differentials are produced even at pressures as low as 6 or 7 psi. The development of the plastic insert tube now permits the economical metering of propane, carbon dioxide, oxygen, dry chlorine, and wet or dry sulfur dioxide. It has been successfully used with steam.

Liquids containing solids. When the Dall tube was first introduced, the manufacturer was hesitant to use it for metering liquids containing settleable solids such as raw sewage and activated sludge. It was feared that the solids would accumulate at the uptream dam and plug the throat slot, thus changing the operation of the meter. A 20-in. flow tube was installed to meter raw sewage at the Salem-Beverly sewage treatment plant in Massachusetts in 1954 and has operated for five years without trouble. Also in 1954 an 8-in. tube was installed at the Cranston, R. I., plant to meter return activated sludge. After over four years of service, this tube was removed from the line for examination and immediately photographed. The water droplets still clinging to the handles of the flushing connections can be seen in this view, included here. There is no accumulation of solids either at the upstream dam or in the throat slot. These two long-term tests show that by the use of proper flushing connections, Dall flow tubes have wide applications for metering in sewage treatment plants.

Ship bunkering facilities for a cargo pier

JOACHIM E. LIEBMANN, F. ASCE, Chief Engineer, Port of San Diego, Calif.

In the highly competitive business of seaport operations, fast turn-around time for ocean-going vessels is of prime importance. Ports are constantly seeking new ways to attract ship calls through improved operating procedures. One of these inducements to attract owners is a means of fueling ships quickly and at low cost.

At the Port of San Diego, the construction of the 10th Avenue Marine Terminal included berthside bunkering. Vessels can take on fuel at any of the nine berths and load and unload cargo at the same time. This service is one of the unusual features of the huge marginal wharf completed last year after three years of construction, at a cost of slightly over ten million dollars. (See the article by Greer W. Ferver, M. ASCE, and the writer, CIVIL ENGINEERING, Nov. 1958, vol. p. 820.)

The facility has actually a threefold purpose:

- To reduce the ship's time in port by making it unnecessary to move to a special fueling pier.
- To provide for most economical handling of ships' fuels so that they can be sold at prices competitive with those at other ports.
- To make is unnecessary for a ship to call at another port for the sole purpose of taking on fuel. This attracts cargo for discharge as well as for export.

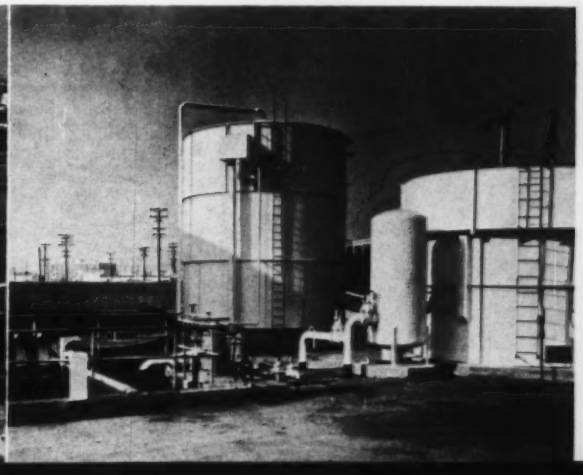
No one seemed to know of any similar installation, at least not along the West Coast, which might have served as an example. Some knowledge was gained by observing the operations at docks used exclusively for fueling, although there the problem of simultaneous cargo handling is not encountered. At one port Bunker C Fuel was pumped directly from refinery storage tanks to dockside risers on general cargo piers. These particular docks were on a preferential berthing basis, that is, they were used by one steamship company only. Valuable information and advice came from the ship engineers, the City Fire Marshal's office, and others with merchant marine or Navy experience. After a thorough analysis the design criteria given in Table I were adopted.

Three bunkering lines ranging in size from 6 to 10 in. run from the pumping station adjacent to the storage tank area to the nine fueling stations along the wharf perimeter. Each fueling station has three 6-in. loading risers, one serving each bunkering line. The shutoff valves and the flanges to which the flexible hoses are connected during fueling operations are located in pits recessed into the quay wall.

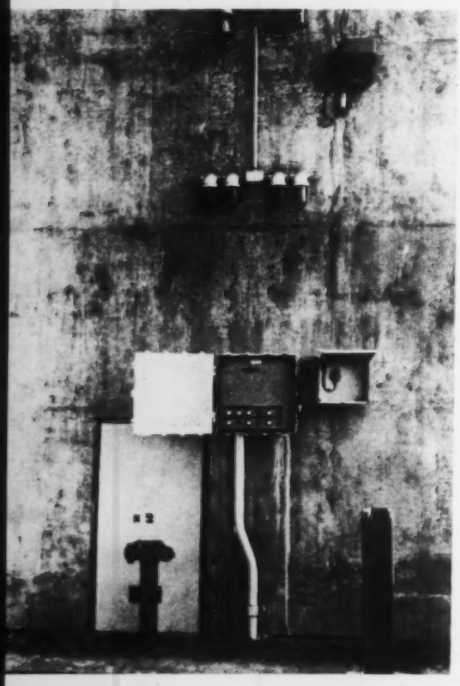
The Bunker C and Light Domestic Fuel lines comprise a common system, so that they can be used interchangeably or both together for either fuel. The two lines are cross-connected at the far end. This permits the displacement of the heavier Bunker C, which has to be heated for easier pumping by the more fluid Light Domestic Oil, a desirable arrangement during long periods of shutdown. The 6-in. Diesel Oil line forms a separate system to avoid contamination of this fuel. Isolating valves were installed where the fueling lines cross the bulkhead line and also at the midpoint of the long outboard face of the wharf.

Two unloading lines, one 14-in. for Bunker C and Light Domestic Fuels and a separate 12-in. Diesel Oil line,

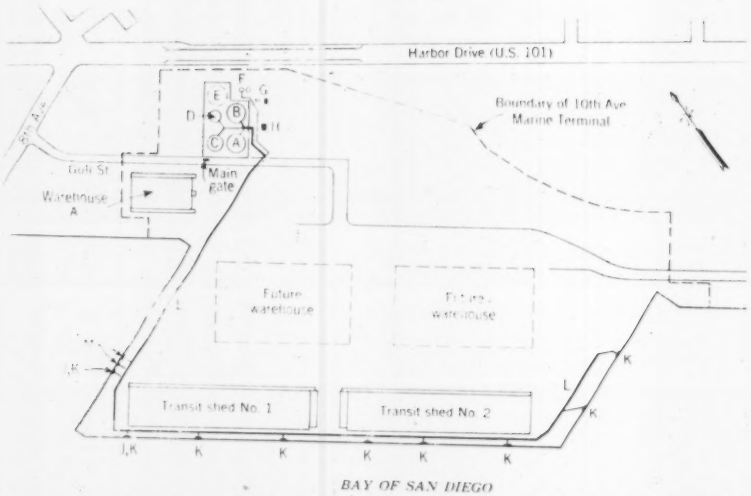
Pumping station manifold (below left) permits versatile use of all pumps except the one for handling Diesel Fuel. Also shown in photograph is fuel-oil heater (left rear), used to keep the Bunker C fuel at a good pumping temperature. Ballast water treating plant (below right) uses an air flotation separator to remove the residues of oil from the ballast water before the water passes to a storm drain. This is a continuous automatic operation requiring practically no attention.



At dockside, diesel fuel is loaded through flexible hose in foreground and tallow through larger line.



Close to each set of fueling risers is mounted a control cabinet with a start and a stop button for each delivery pump. Colored lights above the cabinet indicate which pumps are running.



A, B, C, D are bunkering tanks; E is a future tank site; F, ballast-water treating unit; G, fuel-oil heater; H, pumping station; J, ballast pump-off; K, fueling station; L, bunkering lines; M, receiving station.

FIG. 1. Fueling facilities at Tenth Avenue Marine Terminal, Port of San Diego, allow ships to receive fuel while loading and unloading cargo.

run from the unloading berth or receiving station in the northwest face of the wharf to the storage tanks. Each line has two 8-in. unloading risers which are also placed in underground pits.

All underground lines are coal-tar coated and wrapped in accordance with AWWA Specification C-204-55. Areas adjacent to all risers were paved with portland-cement concrete because of the deleterious effect that even minor spillage of these oils has on the asphalt concrete surfacing generally used in the wharf.

Five pumps for three fuels

At present five pumps are handling the three types of fuel. Three of these are Allis-Chalmers centrifugal, with a capacity of 1,000 bbl per hr (700 gpm), driven by 125-hp electric motors. One is used solely for pumping Diesel Fuel, another mainly for Light Domestic, and the third, originally intended as a standby, often for either the Light Domestic or the Bunker C Fuel to increase loading rates. The other two pumps, manufactured by Sier-Bath, are of the rotary type, and handle primarily the Bunker C Fuel. A screw pump of 1,000 bbl per hr, driven by a 150-hp motor, is chiefly used for delivering this fuel, and a smaller gear pump of 350 bbl per hr for circulating it through the heat exchanger. The manifold permits versatile use of all pumps except the one for handling Diesel Fuel. They can also be used for transferring liquids between tanks and removing major oil spills in the impounding basin. Provisions have been made for the future installation of two additional pumps to develop the fuel delivery capacity of the plant.

The desirable minimum pumping temperature for the heavy Bunker C Fuel, for economical handling, is 120 to 125 deg F. It was anticipated that in an insulated tank the oil temperature might drop as much as 5 deg F during a cold winter day and night. Of course freezing weather is an extremely rare

TABLE I. Design criteria for fuel handling

Type of fuels to be handled	Three—heavy Bunker C, Light Domestic, and Bunker Diesel Fuels
Normal bunkering rate per vessel	1,000 bbl per hr
Maximum number of ships to be fueled at one time at above rate	Ultimately six, two for each type of fuel
Maximum allowable pressure in flexible loading hoses	125 psig
Design loading temperatures	125 deg F for Bunker C Fuel, ambient for Light Domestic and Diesel Fuels
Tanker or barge unloading rate	10,000 bbl per hr
Ballast-water unloading capacity	1,000 bbl per hr (700 gal per min)
Maximum allowable oil content in ballast water after treatment	20 ppm

occurrence along the shore of San Diego Bay where the tanks are located.

Several possibilities were explored for keeping the Bunker C Fuel at reasonable pumping temperatures—tank heaters, a direct-fired heater, and a steam generator with a heat exchanger. The last method was eventually chosen for the following reasons:

1. It proved to be the most economical of the three.
2. Continuous presence of an attendant is not required as in the case of a direct-fired heater.
3. It is operationally more flexible than the tank heaters.

The installed heating facility essentially consists of a 7,000,000-Btu oil-fired boiler operating at a maximum pressure of 15 lb, a heat exchanger, the previously mentioned gear pump of 350 bbl per hr, and of course, the necessary lines and valves. The contents of any tank can be circulated through the heat exchanger, which appears to operate most efficiently if the oil temperature is raised to about 140 deg F. Experience has shown that about seven hours of heating are required to raise the temperature of the oil in Bunker C tank 8 deg F. So far, the daily temperature drop when no heating has taken place has been only 3 to 4 deg F. At present Bunker C Fuel is stored at temperatures ranging between 100 and 110 deg F. During a fuel delivery, the stream is split and part of it is passed through the exchanger. The combined stream is then delivered at about 120 deg F.

The present storage capacity consists of four American Petroleum Institute cone-roof tanks:

One 55,000-bbl tanker for Bunker C Fuel
One 55,000-bbl spare tank
One 35,000-bbl tank for Light Domestic Fuel
One 20,000-bbl tank for Diesel Fuel

The tank shells, all 40 ft high, rest on concrete ring foundations. The Bunker C tank is insulated with 2 in. of fiberglass covered by asbestos-cement board 3/16 in. thick. Provisions have been made for the possible future insulation of the other large tank. The impounding basin is formed by a reinforced concrete wall 6 ft high. Its capacity equals the volume of one of the large tanks plus 10 percent of all others, including a future fifth tank for which a site has been prepared inside the basin. This is the minimum requirement of a local city ordinance. Each tank is separated from the next by a subdike 2 ft high. Thus, five drainage basins are created, each with its own drain line running to the clear-water compartment of a sump located outside the tank enclosure. All tank lines, except for expansion loops, were placed underground. Tank valves are the only valves located within the impounding basin. Access to the basin is provided by a truck ramp and by a more conveniently located stile near the pump manifold.

Disposal of ballast water

A complete fueling facility should include means for the disposal of ships' ballast water. This is sea water that has been pumped into the empty fuel tanks of a vessel to improve its stability. Ballast water consequently contains residues of oil and may not be discharged into harbor waters, nor for that matter into the sea within 50 miles of the coast.

At first it was planned to install an API separator which would remove the oil from the ballast water by strictly gravity separation. When the local Water Pollution Control Board limited the oil content of the processed water to a maximum of 20 ppm, it was felt that the gravity separator would probably not give acceptable results. Some of the residual oil has almost the same specific gravity as water. It was decided, therefore, to install an air flotation separator.

Ballast water is first pumped by the ship through a 6-in. steel line, which parallels the fueling lines on the pier, to a 1,500-bbl ballast tank. There a large part of the light and consequently easily separable oils are drawn off by means of a weir box at the top of the tank. Bottom sediments may be drawn off through another line. Both the light and the heavy oils are discharged directly into an underground slop tank. The water phase, which still contains the less readily separable oils, is drawn off at mid-height of the tank and discharged over another weir into the so-called oily-water compartment of the sump.

A 700-gpm centrifugal pump then discharges the water through a small holding tank into the flotation separator. Air is introduced into the water at the pump and brought into solution under a pressure of about 48 lb in the holding tank. In the open-top separator, oil particles attach themselves to minute air bubbles which form in the water when the pressure is reduced to atmospheric. An oily foam rises to the top and is skimmed off and also discharged into the slop tank. When necessary, sediments can be withdrawn at the bottom. The clean water passes over a weir into the clean-water compartment of the sump and from there into a storm drain. This is a continuous automatic operation and requires practically no attention. The unit is designed so that a part or all of the water will automatically recycle if the ballast water enters the oily sump at a lower rate than 700 gpm.

The need for installing the relatively expensive remote pump control system was much debated. Some felt that sole reliance could be placed on intercommunication telephones. The proponents of the remote-control feature finally won their point when they showed the great possible damage and expense that might result from certain types of accident, which the remote-control system could readily be designed to prevent. Consequently, in close proximity to each set of fueling risers, either on the transit-shed wall or a nearby flood-light stanchion, was mounted a control cabinet with a start and a stop button for each delivery pump. Colored lights located high on the wall or a light stanchion above the cabinet indicate which pumps are actually running. In case of emergency the operator can also shut down all pumps by closing one switch mounted just above each pit containing the fueling risers.

The pumps normally operate at around 200 psi while the flexible loading hoses were designed for a working pressure of only 125 psi. In case of a sudden shutoff on board ship, which occurs occasionally, hose rupture could result. This danger was eliminated by placing an overpressure switch in the loading riser between the shutoff valve in the pit and the flexible hose connection. At a pressure of 125 psi in any riser, this switch will shut down all the pumps. They then have to be started manually after the cause of the overpressure has been eliminated.

At the beginning some difficulty was encountered by the operators. At times it became impossible to keep any pump running without turning off the entire remote-control system. This trouble was finally traced to a build-up of pressure in some Diesel Fuel risers, which kept the respective overpressure switch in the closed position. The gate valves in the loading risers simply could not be shut off completely against the Diesel Fuel. This was easily remedied by installing a toggle switch at each remote-control cabinet, which could make the overpressure switches at that station inoperative. At stations where fueling operations are taking place, the toggle switch is turned on after first bleeding the Diesel Fuel riser to relieve the pressure.

Since there are at present no refineries in the San Diego area, fuel shipments are brought to the terminal by barge or tanker from the Los Angeles area, about 90 miles to the north.

ENGINEERS' NOTEBOOK

A rubber stamp for beam design

ALLEN JONES, JR., A.M. ASCE, Structural Engineer, Knoxville, Tenn.

For designing beams in my office, the rubber stamp shown in Fig. 1 has proved very useful. The stamp represents a simple span. When multiple

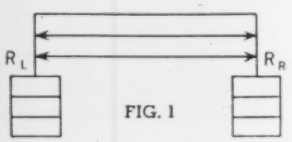


FIG. 1

spans are designed, requiring moment distribution, two or more "beams" are stamped side by side.

The principal advantage of the stamp is that the designer always works on familiar ground. Each beam is calculated in the same way. When the same beam is referred to again—say a week later—there is no confusion or loss of time.

Reactions for the example in Fig. 2 can be obtained by using the A and B scales on the slide rule. The load is divided by the total span; then each

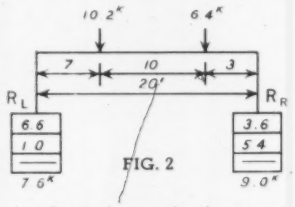


FIG. 2

reaction is read opposite its segmental distance without moving the slide.

Uniform loads appear in the second example, Fig. 3. The total uniform load W has been computed in each case and offers a convenient check when the total beam load is compared with the sum of the reactions. Percentage of dead load is also shown, the dead-load reactions being tabulated alongside the total load reactions. Uniform loads are computed first, then concentrated loads, from left to right, always in the same order.

On a recent job in my office, this stamp was used 36 times in one week. If even one minute is saved on each use, the stamp will pay for itself in two busy weeks. The cost at a local office supply store was $5.00.

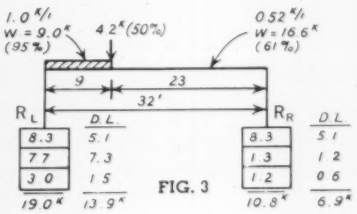


FIG. 3

SHIP BUNKERING FACILITIES *(Continued)*

Pumps aboard these vessels are used to discharge the fuels into the storage tanks. This makes it impracticable to install automatic pump shutoffs designed to prevent tanks from being accidentally overfilled.

As a substitute, high-level alarms actuated by the automatic tank gages were installed. When the liquid level in any tank reaches a height one foot from the top, yellow warning lights go on at the pump-station operator's house and at the fuel unloading or receiving station. If pumping into the tank is continued and the liquid level reaches 6 in. below the top angle, red lights at locations mentioned call attention to the imminent danger of tank overflow. In addition alarm horns sound, which require immediate cessation of all pumping operations at the terminal. The alarm horns can also be sounded by pressing buttons at the operator's house and from within the tank enclosure.

Somewhat more than a year has elapsed since the facility was placed in operation by the Union Oil Company under a five-year agreement with the Port. Deliveries during the first year substantially exceeded anticipations and the installation has been enthusiastically received by all those concerned with it.

So far it has been possible to schedule the bunkering activities so that each line serves only one vessel at a time. Delivery volumes are therefore still determined by gaging the storage tanks. Before too long it may become necessary to have on hand portable large-capacity flow meters so that two or more vessels can be served simultaneously over the same bunkering line.

Although all fueling risers terminate in a 6-in. flange, the operator has elected to use only 4-in. flexible loading hoses because they are so much easier to handle. Loading rates over one such hose have exceeded 1,400 bbl per hour.

The treatment plant for ballast water also is functioning effectively and well within the limits of the design criterion of 20 ppm of residual oil. Tests have shown results as low as 6 ppm. From experience to date one can expect consistent results of 15 ppm as long as the equipment is operated properly.

The total cost of the bunkering facility was somewhat over $800,000, which almost coincided with the pre-engineering estimate. Actually, the manifolding, pumping station, and ballast-water treating plant cost considerably more than had been anticipated. However, this was fortunately offset by savings achieved through the installation of a concrete ring rather than pile foundations under the storage tanks.

The storage tanks, their foundations, and the impounding basin wall cost about 40 percent of this total. Approximately another 40 percent was expended on the pumping station and ballast-water treating plant, including pumps, manifolding, fuel-oil heater, the primary electric distribution center, and appurtenant items. The remaining 20 percent covered the cost of the pipeline installation on the pier.

Most of the design work and all the construction inspection was done by the engineering staff of the Port of San Diego under the writer's direction.

Concrete mixes designed by nomograph

GUY F. TABOR, JR., A.M. ASCE, Assistant Chief Soils Engineer

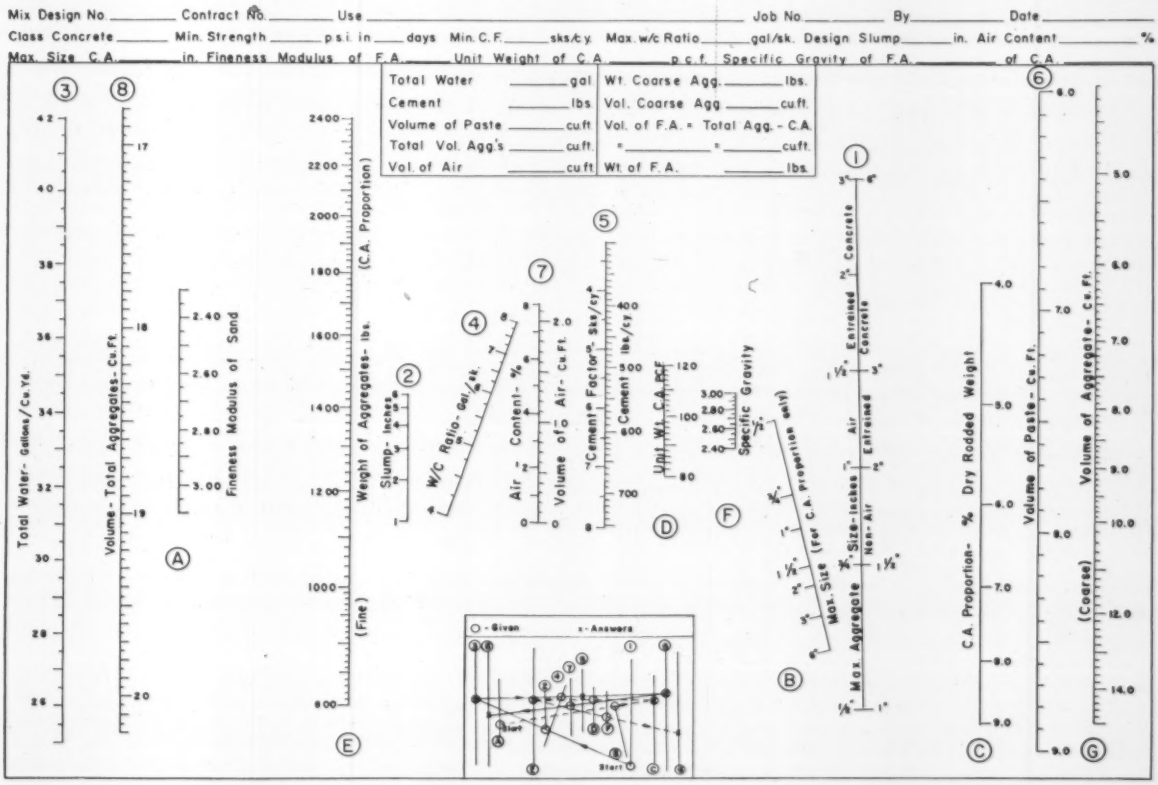
Howard, Needles, Tammen & Bergendoff, New York, N. Y.

Concrete-mix design has been performed in many ways from "1-2-4 shovels full" to extensive trial batching. These methods have provided some excellent concrete, but also some very poor concrete. In 1944 the American Concrete Institute fostered a standard that was helpful but not complete, and still required considerable experience. In September 1954, a new standard, ACI-613-54, was published which utilized existing tests of properties of materials to determine the mix proportions. This was accomplished by analysis of many mix designs, which had been collected by the ACI. The result was two tables (Nos. 3 and 6) which provided an excellent base for analytical concrete-mix design.

The accompanying nomograph, an original piece of work by the writer, is based on these two tables and standard equations for the calculation of such concrete properties as absolute volume and yield. Its purpose is: (1) to make use of these advanced procedures in mix design, (2) to simplify the procedure so that laboratory technicians can prepare the design with a minimum of instruction, and (3) to save design time and thus reduce the cost of the mix design. All these factors have served to make the nomograph a useful tool, both in original mix design and in checking the designs of others. Recently a number of mix designs prepared by an outside laboratory were analyzed in about 15 percent of the time otherwise required.

In our laboratory the nomograph is used as a printed form having only one mix design per sheet. This provides a permanent record of the nomographic calculations, eliminates clutter on the printed form, and simplifies the filing. A key for the use of the nomograph is provided in the lower center of the form. The general procedure is:

1. Fill in all known data at the top of the form.
2. Start the nomograph with the number key (this is really two nomographs superimposed) and determine "Total Water" through "Total Volume of Aggregate."
3. Use the letter key to determine "Weight" and "Volume of Coarse Aggregate."
4. From this calculate the remaining "Volume of Fine Aggregate."
5. Then, using the letter key again, beginning with "G" and going backwards through "F" to "E", determine the weight of "Fine Aggregate."
6. All the quantities have been determined, and the result can be checked by totaling the volumes to 27 cu ft.


Mix Design No. _____ Contract No. _____ Use _____ Job No. _____ By _____ Date _____
Class Concrete _____ Min. Strength _____ p.s.i. in ____ days Min. C.F. _____ sks/c.y. Max. w/c Ratio _____ gal/sk. Design Slump _____ in. Air Content _____ %
Max. Size C.A. _____ in. Fineness Modulus of F.A. _____ Unit Weight of C.A. _____ p.c.f. Specific Gravity of F.A. _____ of C.A. _____
Total Water _____ gal
Cement _____ lbs.
Volume of Paste _____ cuft
Total Vol. Agg's _____ cuft.
Vol. of Air _____ cuft
Wt. Coarse Agg. _____ lbs.
Vol. Coarse Agg. _____ cuft.
Vol. of F.A. = Total Agg. - C.A.
= _____ = _____ cuft.
Wt. of F.A. _____ lbs.
Total Water- Gallons/Cu.Yd.
Volume - Total Aggregates - Cu.Ft.
Fineness Modulus of Sand
Weight of Aggregates - lbs.
(C.A. Proportion)
(Fine)
Slump - Inches
W/C Ratio - Gal./Sk.
Air - Content - %
Volume of Air - Cu.Ft.
Cement Factor - sks/cy.
Cement - lbs/cy
Unit Wt. C.A. PCF
Specific Gravity
Max. Size (For C.A. proportion only)
Entrained Concrete
Air Entrained Concrete
Non-Air Entrained
Max. Aggregate Size - Inches
C.A. Proportion - % Dry Rodded Weight
Volume of Paste - Cu.Ft.
Volume of Aggregate - Cu.Ft. (Coarse)
○ - Given
x - Answers
Start

By Guy F. Tabor, Jr.

A chart for intermediate moments

KEITH A. KELLY, F. ASCE, Chief Engineer, Baker-Wibberley & Associates, Inc., Hagerstown, Md.

In designing a simple-span highway bridge, the structural engineer must often determine the maximum live-load moments at several points along a beam. Knowledge of the maximum stresses produced by the passage of live load is essential to the computation of the adequate beam cross-section at all points along the beam and is especially applicable to the determination of cover-plate lengths and points of reduction or for the draping of reinforcing steel or prestressing strands.

Tabular values for the absolute maximum live-load moments for varying span lengths are given in the AASHO Specifications for Highway Bridges (1957 edition, Appendix A, p. 245). Maximum live-load moments at other points on any given span can then be determined by the rather simple but tedious application of the live load to an appropriate influence line.

The accompanying chart gives the maximum moments at intermediate points of any span, produced by the H20-S16 live load, expressed as a percentage of the above absolute maximum live-load moment.

Example 1. It is desired to find the maximum moment produced by an H20-S16 live load at a point 10 ft from the end reaction of a simple span 40 ft long. From the AASHO tables, the absolute maximum live-load moment is found to be 449.8 ft-kips. Referring to Case III, Fig. 1, it is seen that for a span of 40 ft and a k-value of $10/40 = 0.25$, the corresponding ratio of the maximum live-load moment at 10 ft to the absolute maximum live-load moment is 82.7 percent. Therefore the maximum live-load moment at 10 ft is $0.827 \times 449.8 = 372.0$ ft-kips.

Example 2. It is desired to find the maximum moment produced by an H20-S16 live load at a point 21 ft from the end of a simple span 60 ft long. From the AASHO tables, the absolute maximum live-load moment is found to be 806.5 ft-kips. Referring to Case IV, Fig. 1, it is seen that, for a 60-ft span, and a k-value of $21/60 = 0.35$, the corresponding ratio of the maximum live-load moment at 10 ft to the absolute maximum live-load moment is 93.4 percent. Therefore the maximum live-load moment at 21 ft is $0.934 \times 806.5 = 753.2$ ft-kips.

It may be noted that for spans in the range of Case I in Fig. 1, the intermediate moments have a parabolic relation to the absolute maximum. However, for other span lengths, the actual values may exceed the values resulting from an assumed parabolic variation by ratios ranging from 5 percent at 0.40 L to 39 percent at 0.05 L.

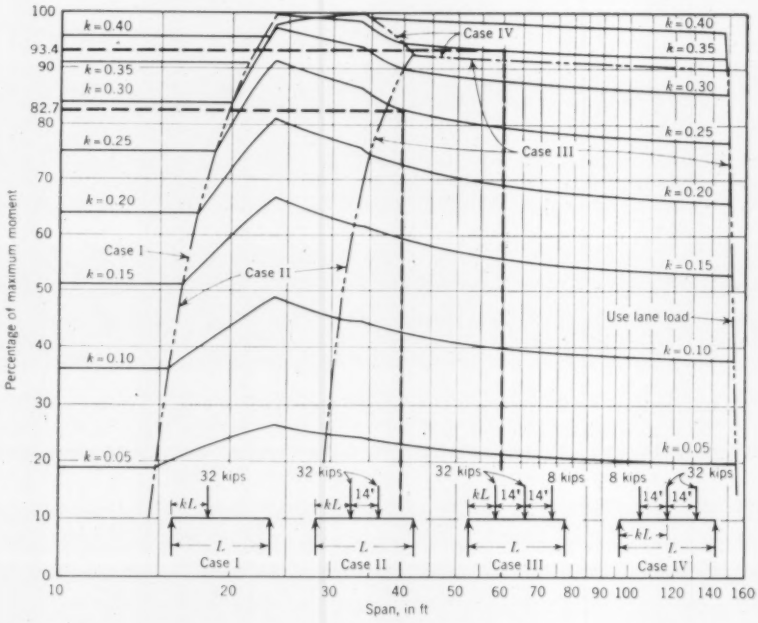


FIG. 1. Chart gives curves for determination of live-load moments at intermediate points on simple spans.

Engineering Education to Be Studied at EUSEC Conference

A comparative study of engineering education in twenty countries will be the objective of the plenary session of the Conference of the Engineering Societies of Western Europe and the United States (EUSEC), to be held in Brussels, Belgium, August 29-September 3. The study will cover the twenty countries participating in the conference, including the United States. According to present plans, a detailed report on engineering education, including the number of students represented in each of the branches of engineering, will be made available for each of the countries taking part. It is hoped that it will be possible to have a final summary report ready by the end of 1960.

The study, which is under the sponsorship of the EUSEC Committee on Engineering Education, is being financed by a $60,000 grant from the Ford Foundation and the Office of European Economic Cooperation. As current secretariat of EUSEC, the Society is continuing trustee of the fund. Thorndike Saville, F. ASCE, is chairman of the EUSEC Committee on Engineering Education.

Twenty-three national engineering societies in sixteen countries are now represented in EUSEC. Newcomers to the list are the Institution of Civil Engineers of Ireland and the Institution of Mechanical Engineers of Great Britain. EUSEC was established at a conference held in London in 1948, with the aim of developing closer working relationships among the national engineering societies of the free nations. Executive Secretary W. H. Wisely is currently general secretary of EUSEC.

THE READERS WRITE

Encouraging response to computer program descriptions

Typical of the widespread interest aroused by the Structural Division's series of computer program descriptions are the following excerpts from letters received by John J. Kozak, chairman of the Division's Task Committee on Program Directory and Library. This feature in CIVIL ENGINEERING, *entitled "Electronic Computer Applications" was started in the December issue (vol. pp. 886-887) to further the committee's aim of presenting a comprehensive directory of computer applications. Additional descriptions appear in the current issue, p. 80. Program correspondence should be addressed to Mr. Kozak, ASCE Task Committee, P.O. Box 1499, Sacramento 7, Calif.*

We have read with interest the descriptions of the computer programs in the December issue. We have two programs that should be of interest to readers and we are enclosing descriptions of them. Both are in use here with very satisfactory results.

JAMES S. HOFFMAN, A.M. ASCE
Programming Engineer
Iowa State Highway Commission

Ames, Iowa

* * *

I must commend you and your committee for the fine task taken up. It shows the importance of computers in our profession and in our ever advancing technological society. As a contribution to this list I am enclosing a brief description of our program, "Structural Analysis and Design of a Reinforced Concrete Sewer."

CLINT J. KEIFER, M. ASCE
Engr. of Sewer Hydraulics
Dept. of Public Works
Chicago, Ill.

Chicago, Ill.

* * *

I am writing in response to the article on "Electronic Computer Applications" in the December issue. Our firm has contributed a number of programs to the library of the Bendix Users Group, including "Design of Composite Beams" and "Fixed Arch Analysis." If you would prefer to receive information on these programs directly from us, we will be happy to supply you with descriptions.

WALTER KUDLICK
Parsons, Brinckerhoff, Hall
& Macdonald, Engineers

New York, N.Y.

* * *

Enclosed herewith please find descriptions of two programs which were written by and are at present in use by our company. We are planning to submit some more programs in the near future, not only in the structural field but also in highway engineering, surveying and sanitary engineering.

M. TURHAN TANER, A.M. ASCE
Vice President, Scientific
Computers, Inc.

Minneapolis, Minn.

Characteristics of heavy aggregates

TO THE EDITOR: The article, "Aggregates and Aggravations of Heavy-Weight Concrete," by L. D. Long and J. R. Clements in the December issue (vol. p. 876), should prove useful to engineers engaged in the preparation of specifications for nuclear radiation shields.

First, the authors describe a number of high-density aggregates. Concerning ferrophosphorus, it is remarked that this material appeared to hold the concrete "green" and weak for several weeks. In my experience on the construction of a number of "hot cells," there was no trouble with strength pickup but to attain 280 to 285 lb per cu ft required a bit of doing. We concluded that the difficulty arose from the fact that ferrophosphorus is a vesicular slag. The larger particles tend to be lighter in weight because of enclosed voids; the smaller sizes are heavier because more of the voids are exposed and fill with mortar paste during mixing.

"Boron additives" are also mentioned as required for neutron attenuation rather than density. Perhaps it would be well to name these additives and include a word of caution in the case of one of them. Boron-containing materials used as fine aggregate include colemanite, boron frits and boron carbide. Colemanite (specific gravity, 2.4) is the ore from which borax is made. When it is used, the other concrete materials and water must be mixed for 20 min, or so before the colemanite is added in order to get the mix to harden. Boron frits (specific gravity, 2.42) and boron carbide (specific gravity, 2.51) do not have this disadvantage but they are expensive.

It is interesting to note under "Job Problems" that the authors imply other production methods in the sentence that begins, "The standard rules for placing *conventional* concrete . . ." One of these, the preplaced aggregate method, has been rather widely used for high-density concrete work because it virtually eliminates the problem of segregation of aggregates of widely varying specific gravities. This method also facilitates varying the unit weight of the concrete from area to area while promoting monolithic placement (fewer construction joints).

Returning to the conventional method, the use of water-reducing agents should be emphasized. Water is usually the lightest material in high-density concrete; by reducing the water it is possible to replace some of the expensive high-specific-gravity aggregate such as scrap iron and ferrophosphorus with lower-density, less costly ilmenite, etc.—or at any rate to be more certain of attaining the specified unit weight, which the contractor usually sweats to get.

Incidentally, good water-reducing agents are available in retarding, normal, or high-early-setting formulations. These admixes permit a reduction of 15 to 20 percent of the water while increasing placeability.

JOHN C. KING, F. ASCE
Product Development Engr.
The Master Builders Co.

Cleveland, Ohio

Author's reply

TO THE EDITOR: Mr. King has contributed valuable additional information in a field that is comparatively new.

Our experience with ferrophosphorus has been somewhat limited. Since this material is a slag of a vesicular nature, it is natural to assume that there could be considerable variation even in material from the same source. Ferrophosphorus was first used by us in the reactor at Plainsboro, N. J., where the average weight of the concrete was over 300 lb per cu ft. Ferrophosphorus from a different source, which was also very heavy, resulted in concrete weighing well over 300 lb per cu ft. Interestingly enough there was little or no evidence of retardation of setting of the concrete in the laboratory tests of this shipment.

Interesting new information has been received about concrete made with ferrophosphorus aggregate for a project in Canada. Work was stopped when gases liberated from the wet concrete caught fire, resulting in concrete flambé. The cement was changed to a low alkali type; no further peculiarities have been reported.

Boron frits were also used at the Plainsboro Reactor with no resulting problems either from segregation or the setting time. Colemanite with the fines (—30) removed has shown little evidence of affecting the hardening of the concrete although it was added last. We are inclined to believe it is the fines below the 30-mesh that cause trouble.

It is our belief that water-reducing agents should not only be emphasized but specified for all concrete when the concrete temperature exceeds 70 deg F, and may be beneficial at less than this temperature. A water-reducing agent and an air-detraining agent should certainly be available for heavy concrete.

L. D. LONG, *President*
The Gullick-Henderson
Labs., Inc.

Flushing, N. Y.

Specifications for state highway work lauded

To the Editor: Everett S. Preston, Director of the Ohio Department of Highways, and his staff members are to be congratulated on the development of "Specifications for Consulting Engineer Services," as described in the January issue (vol. p. 12). These specifications represent an important contribution in increasing the efficiency of consulting services as used to assist state highway departments.

To the extent that there have been difficulties and misunderstandings between consultants and their highway department clients, a large measure of the cause has been a lack of definition of scope of services and required procedures. Specifications such as these should aid substantially in correcting this situation. Let us hope that other states will follow Ohio's lead.

George H. Leland, M. ASCE
Associate, Edwards and Kelcey Engineers and Consultants

Newark, N.J.

A problem in comparing pipe-flow formulas by nomograph

To the Editor: In the Engineers' Notebook article, "Pipe-Flow Formulas Compared by Nomograph," by Francis S. Y. Lee in the November issue (vol. p. 796), it appears that the author was led astray by two unfortunate errors. One is a small computational error in comparing the Darcy and Manning formulas, the other an incorrect assumption that ". . . the coefficient C of the Hazen-Williams formula and the coefficient C of the Chezy formula are numerically equal."

The relationships between the Darcy f, the Manning n, and the Hazen-Williams C, Eq. 4, should read,

$$f = \frac{2g}{1.486^2}\frac{4^{4/3}}{D^{1/3}}\frac{n^2}{} = \frac{2g}{1.318^2}\frac{4^{1.26}}{D^{0.26}S^{0.08}C^2} \cdot \quad (4)$$

or alternately,

$$n = \frac{1.486}{\sqrt{2g}\,4^{2/3}}\,D^{1/6}\sqrt{f}$$

$$C = \frac{4^{0.63}\sqrt{2g}}{1.318}\,\frac{1}{D^{0.13}S^{0.04}\sqrt{f}} \cdot \cdot \cdot \quad (4a)$$

Inserting n and C in terms of f in the Manning and Hazen-Williams formulas respectively, will of course result in the Darcy formula exactly.

The nomograph presented by Mr. Lee for comparing the Darcy f, the Manning n, and the Chezy C could presumably be extended to include a comparison with the Hazen-Williams C. If it is desired to compare the numerical values of these coefficients, such a nomograph presentation is undoubtedly useful. It should be realized, however, that such a comparison does not attack the heart of the problem —the manner in which f or n or C varies with the pipe (or channel) characteristics and the flow characteristics. All the formulas will give exactly the same results if equivalent coefficients, as given by Eq. 4, are used. It is when non-equivalent numerical coefficients are used that the formulas give different results. The problem is the selection of the "correct" value of the coefficient no matter which formula is used. The selection can only be based on the personal experience of the individual and the published experience of the profession.

Emmett M. Laursen, M. ASCE
Assoc. Prof. of Civil Eng.
Michigan State Univ.

East Lansing, Mich.

Cavity wall construction to prevent leakage

To the Editor: A solution to the problem of "Leakage in Masonry and Curtain Wall Construction" (by R. W. Ehrenberg, December issue, vol. p. 865), is immediately available through the use of cavity wall construction. The research and development work has long since been completed and the field performance of such wall types over many years has indicated their ability to stop water permeation in buildings.

Water permeability tests conducted by the National Bureau of Standards over a period of many years on many types of masonry walls indicate that cavity walls are the least susceptible to water penetration. A 10-in. cavity wall costs no more to construct than an 8-in. solid masonry wall and is less expensive than a 12-in. wall. They have been used on the Gulf Coast for many years, where they have performed admirably under severe wind-driven rains. All nationally recognized building codes permit their use. The Bricklayers, Masons and Plasterers International Union has adopted a resolution recommending cavity wall design to the profession. The Structural Clay Products Institute has published technical literature on every aspect of their design and construction. They may be insulated with vermiculite at a cost of less than $0.15 per sq ft to produce U values as low as 0.12.

Personally I am convinced that the best way now known to enclose most building types is a vermiculite-insulated, masonry cavity wall. In the course of ten years in the masonry industry, I have never heard of a leaking cavity wall.

Clayford T. Grimm
Asst. Director, Eng. and Tech.
Structural Clay Products Inst.

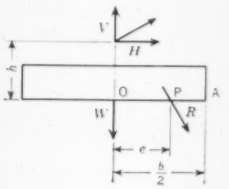
Washington, D.C.

More on factors of safety for footings

To the Editor: The following comments are offered on Mr. Bertwell's article, "Factors of Safety Against Overturning or Sliding," in the November issue (vol. p. 797). Mr. Bertwell's discussion of "correct" factors of safety is based on the fact that he does not reduce forces V and W to their algebraic difference, even though they are directly opposed. These forces are kept separate and distinctly introduced in the analysis as "overturning" and "resisting" forces respectively. This contradicts the principle of composition of forces applied to a point, which is a direct corollary of Galileo's principle of the independence of the effects of forces.

Factors of safety against overturning. The apparent confusion mentioned by Mr. Bertwell results from the fact that civil engineers have tried to assign to their structures factors of safety similar to those used in work on the strength of materials. Coefficients varying between 1.5 and 4 have been adopted arbitrarily, and confusion has resulted. This is why many engineers, especially those engaged in the design of dams, retaining walls and other hydraulic structures have recognized that the best way to investigate the degree of stability of such structures is to determine the direction and intensity of the resultant of the external forces, and to locate it with respect to the base of the structure. The structure is considered stable as long as the resultant is located within the polygon of sustentation of the structure. The structure becomes more stable as the resultant is closer to the center of gravity of the base.

In the simple case of the independent footing analyzed by Mr. Bertwell, the distance of the point of application of the resultant from the center is found by:



$$\frac{b}{2} - e = \frac{\Sigma M}{\Sigma V} = \frac{(W - V)\,(b/2) - Hh}{W - V}$$

$$= \frac{b}{2} - \frac{Hh}{W - V}$$

$$e = \frac{Hh}{W - V}$$

It would be logical to define the factor of safety, F.S., as the ratio of OA to OP:

$$\frac{OA}{OP} = \frac{b/2}{e} = \frac{(W - V)\,(b/2)}{Hh}$$

which is the "erroneous" factor of safety.

Full advantage will be taken from the footing if the foundation pressure is positive along the whole footing length. This occurs when the point of application of the resultant is located within the middle third (rule of the trapezoid). This can be expressed as $OA/OP \geq 3$ (or F.S. ≥ 3).

The expression for the safety factor advocated by Mr. Bertwell cannot be used universally, even in the case of the simple

independent footing. Indeed, for $OA/OP = 3$, we obtain through a simple calculation,

$$G = \frac{1}{1 - 4\frac{H}{W}\frac{h}{b}}$$

This shows that G cannot be used in practice as a criterion of full utilization of the footing, since it is still a function of the parameters H, W, h, b.

My conclusion is therefore that the notion of a factor of safety against overturning should be forgotten by civil engineers, and replaced by a criterion governing the location of the point of application of the resultant of external forces. In the case of walls or footings, the resultant should be located within the middle third for normal design conditions; in the case of dams, this determination is only the beginning of more elaborate studies leading to the calculation of internal stresses.

Factors of safety against sliding. The friction coefficient f is defined in mechanics as the ratio of the tangential component and the normal component of the reaction at the limit of equilibrium. It is therefore incorrect to express

$$\tan \alpha = \frac{R_T}{R_N} \text{ by } \frac{H + Vf}{W}$$

as Mr. Bertwell does.

Regardless of the fact that V is a force inducing instability, the normal component of the reaction is $\vec{W} + \vec{V}$ (scalar values) and its tangential component is $\vec{H}$.

The "correct" factor of safety against sliding proposed by Mr. Bertwell cannot therefore be accepted. The only expression which is in agreement with basic mechanics is:

$$G_s = \frac{\tan \phi}{\tan \alpha} \text{ with } \tan \alpha = \frac{\vec{W} + \vec{V}}{\vec{H}}$$

MARCEL BITOUN, M.ASCE
Hydraulic Engineer
Harrisburg, Pa.

Author replies

TO THE EDITOR: Mr. Bitoun objects, first, to the separation of overturning and resisting forces. The reason for this is not evident to the writer. So long as all the forces are applied, in the correct magnitude and direction, the grouping of the forces will not change the distribution of the reactions from the foundation, or the stresses in the structure. It is often desirable, however, in studying the effect of any individual force, to keep its effect isolated.

Factors of safety are used to gage the effect of changing various magnitudes, and must be carefully defined. Once defined, the figures must be arranged to correspond. In this case the quantity subject to change is defined as the active overturning force P, and it is not logical to remove one of its components when investigating the effect on overturning or sliding of a variation in P. Although the writer has apparently failed to make himself clear in words and symbols, he hopes the numerical examples in the following will illustrate the point.

Perhaps the validity of Eq. 1 of my article in the November issue (vol. p. 797) will be evident if the overturning moment is expressed initially in terms of the inclined force, P, rather than its components. Let the angle between P and the horizontal be γ. Then

$$P\left(h \cos \gamma + \frac{b}{2} \sin \gamma\right) = \text{moment of the overturning force, } P, \text{ about toe of footing}$$

$$W\frac{b}{2} = \text{resisting moment available, also about toe of footing}$$

At the instant of failure, P has increased to GP, and

$$GP\left(h \cos \gamma + \frac{b}{2} \sin \gamma\right) = W\frac{b}{2}$$

From which $G\left(Hh + V\frac{b}{2}\right) = W\frac{b}{2}$

$$G = \frac{W\frac{b}{2}}{Hh + V\frac{b}{2}}$$

Numerical example: $h = 10$, $b = 10$, $W = 20$, $H = 3$, $V = 2$.

$$e = \frac{3 \times 10}{20 - 2} = \frac{5}{3}$$

If it is logical that $G = b/(2e)$, as Mr. Bitoun states, then

$$G = 5/(5/3) = 3$$

If this is correct, multiplying both H and V by 3 should bring the foundation resultant to the toe of the footing. Then

$$e_{ult} = \frac{(3 \times 3)\,10}{20 - (3 \times 2)} = 6\frac{3}{7}$$

But this value of e_{ult} places the resultant far outside the footing.

On the other hand, if Eq. 1 is correct,

$$G = \frac{20 \times 5}{3 \times 10 + 2 \times 5} = 2.5$$

$$e_{ult} = \frac{(2.5 \times 3)\,10}{20 - (2.5 \times 2)} = 5.0 = \frac{b}{2}$$

as required.

The corresponding detailed derivation of Eq. 2:

$P \cos \gamma$ = force causing sliding

$(W - P \sin \gamma)$ = available resisting force

At the instant of failure P has increased to G_sP, and

$$G_sP \cos \gamma = (W - G_sP \sin \gamma) f$$

$$\text{or } G_sH = (W - G_sV) f$$

$$G_s = \frac{Wf}{H + Vf} = (2)$$

Numerical example: $h = 10$, $b = 10$, $f = 0.6$, $W = 20$, $H = 3$, $V = 2$.

Mr. Bitoun states then $G_s = \dfrac{\tan \phi}{\tan \alpha}$

$\tan \phi = 0.6$, $\tan \alpha = \dfrac{H}{W - V} = \dfrac{3}{20 - 2} = \dfrac{1}{6}$

Then $G_s = \dfrac{0.6}{1/6} = 3.6$

Multiplying both H and V by 3.6 should mobilize the entire available resisting force against sliding, and $\tan \alpha$ should equal $\tan \phi$, or 0.6. But

$$\tan \alpha = \frac{3.6 \times 3}{20 - 3.6 \times 2} = \frac{10.8}{12.8} = 0.843$$

The footing is far past the point of sliding failure.

On the other hand, if Eq. 2 is correct,

$$G_s = \frac{20 \times 0.6}{3 + 2 \times 0.6} = \frac{12}{4.2} = 2.86$$

$$\tan \alpha = \frac{2.86 \times 3}{20 - 2.86 \times 2} = \frac{8.58}{14.28} = 0.6,$$

as required.

Mr. Bitoun apparently intended to solve Eq. 2 for f when he compared R_T/R_N with $\dfrac{H + Vf}{W}$. However, this leaves f still involved in the result. The correct comparison should be R_T/R_N with $f = \dfrac{G_sH}{W - G_sV}$.

These are equal at the point of failure.

Mr. Bitoun's statement that the "normal component of the reaction is $W + V$ (scalar values)" is mystifying to the writer. Since a scalar value has no direction, $W + V$ (scalar) will always be larger than W, whereas the total reaction must be less than W when V is directed up.

It is completely impractical to forget the "notion" of factor of safety against overturning, as Mr. Bitoun suggests. For example, many, if not all, of the building codes in this country require a factor of safety of not less than 1.5 against overturning by wind. There is no other guide available to provide a given margin of safety in sizing a footing which serves as an anchor against wind uplift.

Dam designers, as stated in the Bureau of Reclamation's Monograph No. 19, of October 1953, consider that "it is desirable to provide an adequate factor of safety against the overturning tendency" of a gravity dam. This is done by the Bureau, and many others, by specifying a maximum permissible stress at the downstream face, because failure of the material must occur before overturning. Such an occurrence is not necessarily true of all structures, however, and then the overturning stability must be specified.

The location of the resultant with respect to the center of a footing is another point to be investigated, but in addition to safety against overturning, not in place of it. The compressibility of the foundation soil and the permissible tolerance of a tilt of the footing govern here, and the choice may vary from zero eccentricity to the quarter point of the footing. There is no invariable correlation, however, between overturning safety and the third point of the footing.

In conclusion, it should be noted that the work given in my letter on the subject of the two-column bent is all based on a horizontal overturning force, which leads to equal and opposite vertical reactions V on the footings. If P is inclined, then all the expressions given should be modified as necessary to keep active forces separated from gravity loads.

W. BERTWELL, F.ASCE
Chief Design Engineer
Kaiser Engineers, Div.
of Henry J. Kaiser Co.
Oakland, Calif.

(Continued from page 63)

ASCE entertains visiting Russian engineers and architects at the Engineers' Club. Vladimir A. Kucherenko (with striped tie in front row), who headed the delegation, is flanked by ASCE Past President Needles and Executive Secretary Wisely.

ASCE Sponsors Reception for Soviet Engineers

Technical and professional activities of American engineering societies were explained to 18 Russian engineers and architects at a meeting sponsored by ASCE at the Engineers Club in New York on February 1. The Russian delegation had arrived a few hours earlier, by airplane, for a 20-day tour of the United States. Their intinerary included, besides New York, Philadelphia, Atlantic City, Washington, Raleigh, Miami, Los Angeles, Chicago, Buffalo and Niagara Falls before their return flight to Russia from New York on February 21.

In an address of welcome, ASCE Past President Enoch R. Needles told the group that engineering is a "common language" to engineers everywhere, and that much could be gained in world understanding by an exchange of views and ideas within the profession.

Speaking for the Russian delegation, Vladimir A. Kucherenko, chairman of the USSR State Construction Committee, a high ranking Soviet official, agreed with Mr. Needles that there should be a wider exchange of ideas, and said that engineers and architects everywhere in the world represent progress in the service of mankind.

William H. Wisely, Executive Secretary of ASCE, detailed the operations and activities of American engineering societies, as represented by ASCE functions. This was followed by a lengthy question period.

Of the 18 visitors, six were architects. The engineers represented the fields of construction and education, and the electrical and mechanical branches.

Volunteers Wanted For ECPD Guidance Work

To prevent duplication in the vital work of interesting high school students in engineering as a career, Engineers Council for Professional Development is asking for volunteers to help develop and expand its guidance program for high school students. Noting that individuals and local groups of engineers have at times undertaken guidance work without being aware of the coordinating role played in this field by its Guidance Committee, ECPD states that the cooperation of school authorities cannot be maintained in guidance work without a unified professional approach.

Some years ago, ECPD State Guidance Committees were organized to coordinate the efforts of engineering groups engaged in guidance activity, to interest additional individuals or groups in guidance in order to obtain nationwide coverage of schools, and to promote the adoption of standards for the conduct of the work. These State Committees are grouped into eight regions for administrative purposes. The State Committees work directly with the 30,000 high schools in the country, counseling students to study mathematics and science and urging those with the necessary aptitude to consider a career in engineering. Interest in engineering is aroused through a wide variety of projects and programs.

This nationwide effort requires the assistance of large numbers of engineers. Many are already participating in ECPD coordinated guidance work through committees of their Sections or Branches. Engineers who are not so engaged and who would like to volunteer their services as speakers or in some other capacity, are asked first to find out what their Section or Branch is doing in the field. Many such groups have a representative on their state ECPD Guidance Committee, and others are indirectly represented through membership in local councils of engineering societies. Volunteers for guidance work who are not able to work through such local groups should contact the Executive Secretary at ASCE headquarters.

Report on EJC in 1959 Made by President Needles

(Continued from page 62)

"There will be a most important World's Fair in New York in 1964, and inescapably the portrayals of contemporary and future living must relate to, and be largely dominated by, the various aspects of science and engineering. It is very clear that an EJC Advisory World's Fair Committee can make valuable contributions in this respect, and that its suggestions will be warmly received by the administrative organization of the World's Fair which will shortly come into being. . . .

"Within the past year, a new publication was started, entitled 'The Engineer.' The EJC staff did a remarkably fine job on this, with very limited personnel, time, and money. So much progress was made that the last issue in the fall of 1959 required a printing of 6,000, partly called for by individual requests to EJC headquarters. Now we are about to embark on a new publication, one which will have skilled guidance and expanded treatment of important subjects of interest to all

engineers. The goal, soon to be realized, is that a copy of this publication shall go to every individual member of the constituent societies of Engineers Joint Council. We are moving forward."

New EJC Officers Installed

EJC officers for 1960 were installed during the annual meeting. The new president is Augustus B. Kinzel, vice-president of research for the Union Carbide Corporation, a past president of the AIME, and a pioneer in the development of atomic energy. The new vice president is Cecil Boling, president of Dunham-Bush, Inc., West Hartford, Conn., an authority on heat transfer, and a former president of the American Society of Heating, Refrigerating, and Air Conditioning Engineers.

Papers Due For Eighth Hot Laboratory Conference

The Hot Laboratory Division of the American Nuclear Society announces that summaries of papers to be submitted for the Eighth Hot Laboratory and Equipment Conference—to be held in San Francisco, Calif., December 11-14, 1960—are due before May 16. This meeting will be held simultaneously with the American Nuclear Society winter meeting, and in conjunction with the nuclear industry exhibit and meeting of the Atomic Industrial Forum. Papers are invited on all phases of hot laboratories and equipment for handling radioactive material, such as design and construction of facilities and equipment, dry boxes, manipulators, shielding, operations, and costs.

Engineers interested in submitting papers for the conference should contact the program chairman, James R. Lilienthal, Los Alamos Scientific Laboratory, Post Office Box 1663, Los Alamos, N. Mex., for information regarding the form in which the summaries are to be prepared. Completed papers will be due September 1, 1960.

E. S. Library Issues Bibliography on Indexing

A selected list of references for engineers and librarians concerned with organizing their own files or the files in the engineering offices or libraries where they work has been prepared by the Engineering Societies Library and made available in multilith at $2.00 a copy. The references are to books, pamphlets and magazine articles on filing, classification and indexing, lists of subject headings, and hand-sorted punched-card systems suitable for organizing small collections of engineering books, notes, correspondence, abstracts, reprints, drawings, maps, and similar data.

Identified as ESL Bibliography, the publication may be obtained from the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Pacific Northwest Council to Meet in Tacoma

Beautiful Tacoma, with snow-clad Mt. Rainier looming in the background, will be host to the Twelfth Annual Conference of the Pacific Northwest Council on April 22 and 23. The ASCE Executive Committee will hold its spring meeting during the two-day conference. Preceding the conference, on April 21, there will also be an all-day Local Section Conference, sponsored by the Pacific Northwest Council. This conference will be the first of its kind held in the Society, since it is being undertaken by a regional group without financial or "logistic" support from headquarters.

Leland J. Walker, of the Montana Section, will be chairman of the Local Section Conference. Council chairman is Jack Y. Barnes, of the Montana Section. Harold F. Sitts, Council vice-chairman, heads the Tacoma Section Conference Committee. Mrs. Myron D. Calkins, of Tacoma, is in charge of the ladies' program and the annual banquet and dance. They promise "a super program," and urge all civil engineers in the area to bring their wives and make it an "occasion."

The Winthrop Hotel will be conference headquarters. Friday morning, April 22, will be devoted to a business meeting and conference assembly, and Friday afternoon to technical sessions. A stag dinner and party is planned for Friday night. The Saturday morning program will consist of a field trip to the Lake Seattle pontoon bridge, the largest floating bridge in the world, followed by a field trip lunch and technical sessions at Bremerton. After inspecting the largest dry dock in the world at Bremerton, the party will return to Tacoma. Travel will be by bus. The installation banquet and dance is set for Saturday night at the Winthrop.

As an added conference attraction, a golf tournament is being arranged, the details to be announced later. Registration forms will be mailed to members.

Tacoma, host city to Twelfth Annual Conference of the Pacific Northwest Council, offers much of interest to civil engineers. This downtown view shows snow-clad Mt. Rainier in the background.

Electronic Computer Applications

The following descriptions of applications of electronic computers to the solution of civil engineering problems have been prepared from information assembled by the Task Committee on Program Directory and Library of the Structural Division's Committee on Electronic Computation. The present listing continues the series started in the December issue (page 72).

To assist the Task Committee in its aim of assembling a comprehensive directory of computer applications in the structural engineering field, readers are invited to send information to: John J. Kozak, ASCE Task Committee, P.O. Box 1499, Sacramento 7, Calif.

Program St. 10: Influence lines for Continuous Beam Design

Equipment: Bendix G-15.

Programmed by: Richardson, Gordon and Associates, Pittsburgh, Pa.

Purpose: To compute influence line ordinates for moments and shear at interior supports and at each tenth point in each span.

Limitations: Influence lines for the tenth points can be computed for symmetrical span arrangements only. Limited to three or four span beams supported on rockers.

Input-Output: Input includes the span and moments of inertia for the beam to be computed. Output includes the ordinates of the influence lines for the girder.

Machine Details: Programmed in Intercom 101 in two parts. Part one computes the influence lines for the moments at the interior supports, uses 850 locations and runs approximately 20 minutes. Part two computes the ordinates of the influence line for the tenth points and the reactions, uses 850 locations, and runs approximately 1½ hours.

Availability: Available to members of the Committee on Civil Engineering Applications of the Bendix G-15 Users Exchange Organization through the Program Distribution Secretary.

Program St. 11: Analysis of Rectangular Reinforced Concrete Columns

Equipment: Bendix G-15.

Programmed by: Richardson, Gordon and Associates, Pittsburgh, Pa.

Purpose: To analyze a rectangular concrete column subjected to a biaxial bending and axial load for maximum steel and concrete stresses.

Limitations: Reinforcing steel is limited to 3 rows, must be symmetrical about both axes, and must be all the same bar size.

Input-Output: The input consists of a description of the column and the loads to be applied. The output gives the concrete stress at each corner, the centroid of the final section and the maximum stress in the steel.

Machine Details: Programmed in Intercom 101, using approximately 800 locations. Not readily relocatable. Running time is approximately 5 min.

Availability: Available as above. This program is also available in uncoded form from the Bureau of Public Roads, Washington, D. C.

Program St. 12: Fixed Arch Analysis

Equipment: Bendix G-15.

Programmed by: Vogt, Ivers, Seaman & Associates, Cincinnati, Ohio.

Purpose: To compute influence values for horizontal reaction, vertical reaction and moment at the left support of a fixed arch due to a unit vertical load.

Limitations: Five significant figures; 40 segments or divisions of the arch.

Input-Output: Input includes the length, thickness and coordinates of each segment of the arch. Output includes the six "structural constants" which are coefficients in the simultaneous equations for the three redundants, and the influence values for each redundant for the load positioned at each segment.

Machine Details: Programmed in Intercom 101 using approximately 200 locations. Not relocatable. Average operating time is 20 minutes.

Availability: Available to members of the Committee on Civil Engineering Applications of the Bendix G-15 Users Exchange Organization through the Program Distribution Secretary.

Program St. 13: Moment Distribution and Influence Line Calculation

Equipment: IBM 650.

Programmed by: Washington State Highway Department.

Purpose: To compute influence line ordinates for loads at all tenth points or at the 0.3, 0.5, 0.7 points, to compute the dead load momement curve, and to distribute end moments on a single-story, rigid-frame structure with members of variable or uniform cross section.

Limitations: Maximum of 15 spans for moment distribution. Maximum of 5 spans for influence lines.

Input-Output: Input includes the distribution and carry-over factors, fixed-end moments if they are to be distributed, span length, influence line load to be used, and the value of the uniform dead load. If the frame contains nonprismatic members, a table of fixed-end moment coefficients must be supplied. Output includes the ordinates of the influence line for each tenth point or 0.3, 0.5, and 0.7 point and the end shears for each position of the concentrated load, the ordinates of the dead-load moment curve, and the distributed moments at each joint due to any given fixed-end moments. All data are in fixed point.

Machine Details: Programmed in S.O.A.P. using 1,869 locations. Running time 10 minutes for five-span influence line. Not relocatable.

Availability: Available through IBM 650, Program Library under file No. 9.2.033. Address: IBM 650 Program Library, 590 Madison Avenue, New York, N. Y.

Program St. 14: Suspension Bridge Analysis

Equipment: IBM 650.

Programmed by: Washington State Highway Department.

Purpose: To compute deflections, moments, and shears in the stiffening truss and the cable tensions at the supports of a two-hinged suspension bridge using the "Sine Series" method.

Limitations: All distributed loads, including cable dead load, are assumed uniform. One concentrated load per span.

Input-Output: Input includes a complete description of the bridge configuration, the stiffening truss properties, and the loads to be applied. Output includes the deflections, moments and shears in the stiffening truss and the cable tensions. All data are in floating decimal.

Machine Details: Programmed in S.O.A.P. in two parts. The first part uses 782 and the second 1951 memory locations. Running time is approximately 15 minutes for first bridge load and 12 minutes for each succeeding load applied to the same bridge.

Availability: Available through the IBM 650 Program Library under file No. 9.2.034. Address: IBM 650 Program Library, 590 Madison Ave., New York, N. Y.

Program St. 15: Influence Lines for Moments at Supports of Continuous Spans

Equipment: IBM 610.

Programmed by: Burgwin and Martin, Consulting Engineers, Topeka, Kans.

Purpose: To compute influence lines for moments at the supports of continuous spans due to a unit load at each tenth point.

Limitations: Will handle any number of spans or any variable shape of beam.

Input-Output: Input includes distribution factors for each end of the span and coefficients for fixed-end moments for each tenth point. Output includes the final moments at the supports due to the unit load at each tenth point.

Machine Details: Programmed in basic machine language, tape storage for instructions and machine storage for constants. Readily relocatable. Running time about 57 seconds per cycle with about 6 cycles required for a four-span symmetrical bridge.

Availability: Available on an exchange basis only. Address: Burgwin and Martin, Consulting Engineers, 408 W. 7th Street, Topeka, Kans.

Program St. 16: Composite Beam Design

Equipment: Bendix G-15.

Programmed by: Parsons, Brinckerhoff, Quade & Douglas, New York, N. Y.

Purpose: To design a wide-flange composite beam.

Limitation: Parallel, symmetrical, simple span stringers only. Applied live load must be one of the four AASHO loads. The basic beam section and size of the top cover plate, if any, must be given as input.

Input-Output: Input data include the span and girder spacing, slab dimensions, handbook properties of the wide-flange beam, the size of the top cover plate, the loads, and the allowable stresses. Output values include the size of the bottom-flange cover plate, location of the cover plate cutoff points, the various values for moment, shear, reaction, and deflection needed to complete the design, and the total volume of concrete and steel.

Machine Details: Programmed in Intercom 101. Average running time is 25 minutes.

Availability: Available to members of the Committee on Civil Engineering Applications of the Bendix G-15 Users Exchange Organization through the Program Distribution Secretary.

Program St. 17: Beam Deflections

Equipment: Bendix G-15.

Programmed by: Richardson, Gordon and Associates, Pittsburgh, Pa.

Purpose: To compute deflections at 11 equally spaced points for varying loads and end moments applied to a girder of varying section.

Limitations: Maximum number of points equals 11. Maximum number of concentrated loads equals 11. No more than one cover plate cutoff between each deflection point.

Input-Output: Input includes span, moments of inertia loads and other values required to describe the problems. Output includes the moments and reactions for the vertical loads, the end slopes, and the deflections at each of the 11 points due to the loads and end moments.

Machine Details: Programmed in Intercom 101, using 700 locations. Not readily relocatable. Running time approximately 9 minutes.

Availability: Same as Program St. 16.

Program St. 18: Riveted Plate Girder Design

Equipment: Bendix G-15.

Programmed by: Vogt, Ivers, Seaman, and Associates, Cincinnati, Ohio.

Purpose: To analyze rigid frame piers of up to four spans for final distributed moments, axial forces in the columns, and moments and shears at up to five points in each bay of the cap girder due to various loading conditions.

Limitations: (1) All members must be constant section; (2) maximum of five columns; (3) wind force must be applied at the centerline of the cap girder; (4) does not handle differential settlement of columns; (5) centerline of cap girder must be horizontal, and centerlines of columns must be vertical; (6) results good to five-digit accuracy.

Input-Output: Input includes:

a. Frame dimensions: (1) Cross-section dimensions of all members; (2) length of all members; (3) position of stringers on frame.
b. Applied loads: (1) Dead load of pier cap; (2) horizontal wind force; (3) temperature variation; (4) dead load stringer reactions and dead load cantilever moments; (5) live load stringer reactions and cantilever moment or the position and magnitude of wheel loads for each condition of live load.

Output data include:

a. The joint moments in each member at each joint for all loading conditions.
b. For dead load and all live load conditions: (1) Moments and shears at intermediate points in cap girder; (2) axial force in each column.
c. All stringer reactions if the wheel loads were given.

Machine Details: Programmed in Intercom-1000. Running time for a two-span pier with seven loading conditions is two hours.

Availability: Available to members of the Committee on Civil Engineering Applications of the Bendix G-15 Users Exchange Organization through the Program Distribution Secretary.

[*Editor's Note:* In the December 1959 issue, the L.G.P. 30 was incorrectly described as a Burroughs instrument. It is a product of the Royal Precision Corporation jointly owned by the Royal McBee and the General Precision Equipment Corporations.]

The Younger Viewpoint

Committee on Younger Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	Walter D. Linzing 4751 No. Paulina Chicago 40, Ill.	Judd Hall 3178 Almeria San Pedro, Calif.

The editor this month is Milton Alpern, chairman of the Committee on Younger Member Publications.

First, excerpts from a letter from a concerned student:

"For five years I have read magazine articles and listened to speeches by civil engineers in which the need for civil engineers in the fields of construction and consulting has been stressed. Since these are the fields I am interested in, this need has made me look forward to my graduation with great anticipation. I find that I am not alone; the majority of civil engineers on this campus are also looking forward to careers in these fields.

"As our graduation date nears, however, we cannot help but become disillusioned with the prospects which we see ahead of us. The problem which confronts us is: How do we find an opening in this field?' Our college has one of the finest placement departments in the country, and all major industries interview here. Civil engineers are actively sought by industry (steel, aviation, railroad) and government, but not by consulting or construction firms.

"The many engineers who desire to enter construction or consulting fields have two choices. The first is to accept a position with one of the industrial giants and either work into construction with the giant or leave the giant after a few years and seek construction or consulting work. The other choice for the graduating engineer is to write letters, more or less at random, to construction companies and consulting firms with the hope that one of them may be hiring civil engineers this year. These letters will take up much valuable time of the companies, especially if many of the engineering graduates happen to write to the same place in search of employment. Personal contact in the local area is possible, too, but those of us who wish a geographic change find this angle impossible to follow through.

"Two solutions present themselves at this time. One is to establish a clearing house on the order of an employment agency, which would work in conjunction with construction firms, consultants, ASCE, and ASCE Student Chapters to put employers and employees in touch with each other and to fit the right peg into the right hole.

"The second and the best solution is to establish a college interview group that would represent all the foregoing agencies and function as a placement representative, visiting college campuses throughout the country. If each engineering firm would submit to this group its needs for civil engineers, this group could screen and select with much precision and place the right man in the right job.

"I believe this interview or contact solution is important enough to receive much consideration. Admittedly, there are difficulties which would have to be overcome, but ASCE could establish a group which would be supported by all participating agencies (AGC, Consulting Engineers, Architects, Professional Engineers, and any other groups in which an individual firm is too small to interview on college campuses.)

"Financially, the project looks imposing, but if groups like these would undertake it on a national scale they would realize greater returns in their investments through the use of engineers who are getting into a field they want at a time when their enthusiasm is at peak.

Sincerely,

DUANE R. MIEDTKE,
President, Student Chapter
Univ. of Minnesota"

Heard in corridors of some Engineering Schools: "Bridges, buildings, highways are for technicians. We want our undergraduate students to be ready for the Space Age and rocket design. Out with surveying, out with geology, out with highway engineering, out with reinforced concrete! Substitute advanced dynamics, vector analysis, theory of elasticity and other basic engineering sciences. We don't want our men to be draftsmen lost in the herd!"

But certain engineers and engineering educators wonder if all this isn't unrealistic and very unbalanced in terms of the needs of the engineering profession. What do you think?

One civil engineer has written to state his wonderment at this trend away from "traditional" Civil Engineering while civil engineers have still not caught up with the fact that people in his community still draw water from wells located in very close proximity to their cesspools!

One of the arguments advanced for this substantial scientific orientation of civil engineering curricula is that it is one way to improve the professional stature of the civil engineer since the "ordinary" civil engineering industry will not do it due to its existing low fee and stature structure.

Something to think about, too!

Seventh Conference on Coastal Engineering

All phases of coastal engineering will be studied at the Seventh International Conference on Coastal Engineering, set for August 22-27 in The Hague, Netherlands. The meeting place will be the Kurhaus at Scheveningen. Sponsoring groups are the Council on Wave Research of the Engineering Foundation and the Rijkswaterstaat of the Netherlands.

Among the subjects treated will be the growth and behavior of waves; formation and erosion of coastal forms; coastal protection and flood prevention; design, construction, and maintenance of harbors; tides and stormsurges; and instruments for and methods of investigation. During the meeting visits will be arranged to the Delta Works, the Zuiderzeeworks, and the Hydraulic Laboratory.

Details are available from Prof. J. W. Johnson, University of California, Engineering Field Station, Building 159, Richmond 4, Calif. Engineers abroad should get in touch with J. B. Schijf, Koningskade 25, The Hague.

ASCE Membership as of February 9, 1960

Fellows	10,919
Members	15,797
Associate Members	17,910
Affiliates	94
Honorary Members	47
Total	44,767
(February 9, 1959	42,274)

Little Rock Branch Elects Woman President

The Mid-South Section's Little Rock Branch has made Society history by electing a woman engineer as its head for 1960. The new Branch president is Miss Margaret Petersen, M. ASCE, hydraulic engineer for the U. S. Army Engineer District at Little Rock. Joining ASCE as a Junior Member in 1947, Miss Petersen helped organize the Jackson Branch of the Mid-South Section in 1949 and served it as secretary until she left Jackson in 1952.

A 1942 liberal arts graduate of Augustana College, Rock Island, Ill., with a talent for mathematics and drawing, Miss Petersen got into engineering through work as a draftsman—in the District Engineer offices at Rock Island, for the Special Engineering Division of the Panama Canal, and in the Corps of Engineers' suboffice at Iowa City. She obtained her B.S. in civil engineering from the State University of Iowa in 1947 and an M.S. in mechanics and hydraulics from Iowa in 1953. She was hydraulic engineer for the Waterways Experiment Station at Jackson from 1947-1952; hydraulic engineer for the U. S. Army Engineer Division at Omaha, Nebr., from 1953 to 1955; and since 1955 has been hydraulic engineer at Little Rock. In her present assignment, she is working on the stabilization and channel rectification of the Arkansas River.

For relaxation, Miss Petersen translates articles on hydraulics from the French. She is also studying Russian and looks forward to beginning technical translations from the Russian soon.

ASCE CONVENTIONS

RENO CONVENTION

Reno, Nev.
June 20-24, 1960

ANNUAL CONVENTION

Boston, Mass.
Hotel Statler
October 10-14, 1960

PHOENIX CONVENTION

Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

NUCLEAR CONGRESS

New York, N. Y.
Coliseum
April 3-8, 1960

Program Manager

ASCE

DISTRICT CONFERENCES

DISTRICT 9 COUNCIL

Columbus, Ohio
April 29-30, 1960

Host

Central Ohio Section

PACIFIC NORTHWEST COUNCIL

Tacoma, Wash.
April 22-23, 1960

Host

Tacoma Section

TECHNICAL DIVISION MEETINGS

RESEARCH CONFERENCE ON SHEAR STRENGTH OF COHESIVE SOILS

Boulder, Colo.
University of Colorado
June 13-17, 1960

Sponsored by

Soil Mechanics and Foundations Division

HYDRAULICS CONFERENCE

Seattle, Wash.
University of Washington
August 17-19, 1960

Sponsored by

Hydraulics Division

CONFERENCE ON ELECTRONIC COMPUTATION

Pittsburgh, Pa.
Hilton Hotel
September 8-9, 1960

Sponsored by

Structural Division

LOCAL SECTION MEETINGS

Georgia—Regular monthly meeting at the Architects and Engineers Institute on April 8. This will be an evening meeting.

Intermountain—Regular monthly meeting on the fourth Friday of each month.

Los Angeles—Meeting with several Student Chapters in the Los Angeles area at the California Institute of Technology on April 13; Joint meeting of the Hydraulics Group, the Sanitary Group and the American Meteorological Society at the University of California, Westwood, on March 17, at 8:15 p.m.; dinner meeting of the Sanitary Group at the Engineers Club in the Biltmore Hotel on March 23, at 6:30 p.m.; and dinner meeting of the Transportation Group at the Engineers Club in the Biltmore Hotel on March 24, at 6:30 p.m.

Metropolitan—Annual dinner dance party at the Tavern-on-the-Green on March 14, at 6:00 p.m. Tickets are $7.50.

Philadelphia—Regular monthly meeting at the Engineers' Club on April 12.

Sacramento—Weekly meetings at the Elks Temple every Tuesday, at 12 noon.

Spokane—Joint meeting with the University of Idaho and Washington State University Student Chapters on the WSU campus on March 26.

Texas—Spring meeting in Midland, Tex., April 21-23.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.38	1.13
Baltimore	1.14	1.14
Boston	1.22	1.22
Chicago	1.45	1.43
Denver	1.24	1.21
Houston	1.26	1.26
Kansas City	1.13	1.16
Los Angeles	1.28	1.23
Miami	1.57	1.57
New Orleans	1.18	1.18
New York	1.25	1.28
Pittsburgh	1.07	1.04
Portland (Ore.)	1.27	1.25
San Francisco	1.30	1.24
Seattle	1.06	1.06

Highway Departments

Region	Current	Previous
I, New England	1.01	0.90
II, Mid Atlantic	1.14	1.14
III, Mid West	1.27	1.22
IV, South	1.12	1.14
V, West	1.06	1.03
VI, Far West	1.17	1.13

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II, and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was January 30, 1960.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Guest speaker at the February 4 meeting of the **Akron Section** was J. H. Bradley, of the Ohio Bell Telephone Company. Mr. Bradley spoke to the 39 members, guests and students present, of recent Bell Telephone Laboratories developments in communications.

A full two-day program of talks and entertainment comprised the winter meeting of the **Alabama Section** held recently in Mobile. Principal speaker was Maj. Gen. Walter K. Wilson, Jr., Washington, D. C., deputy chief of Army Engineers for Construction, who told the delegates to the meeting that engineering requirements for ground support equipment for ballistic missiles are almost as complicated as those for the missiles themselves, and shortly will "also be larger and more difficult to build." A number of local engineering problems were discussed by Bart B. Chamberlain, Jr., managing partner of the Citronelle-Mobile Gathering System and by C. L. Cookson, vice-president of J. B. Converse & Company, the engineering firm on the $2-million-dollar Wragg Swamp Canal project. The election of officers concluded the two-day meeting. R. O. Davis (see photo) was elected president; Harry E. Myers, first vice-president; Dr. Earl I. Brown, second vice-president; and Kenneth D. Byrd, secretary-treasurer. New directors are Hugh C. Conser, Jr., Warner Keith, J. F. Freeman, R. S. Woodruff and past president John C. Clark.

Professor R. W. McCloy of the Department of Aeronautical Engineering at the University of Illinois, gave an enlightening talk on developments in air travel, from the Wright Brothers to the present, at the **Central Illinois Section's** recent annual "Ladies Night." Emphasis was placed on the reasons, other than curiosity, for our efforts to conquer space and on some of the more obvious problems associated with space travel. Earlier in the evening Alex Van Praag, Jr., received a Life Membership Certificate.

At a recent meeting of the **Intermountain Section,** David Sargent was named president for 1960. Harry Hodson was elected vice-president, while Dean Hill continues as secretary-treasurer. Warren Curtis, as past president, will be the fourth member of the board.

An interested group heard Dr. Konrad Basler, research instructor in Lehigh University's Fritz Engineering Laboratory, speak at the January 18 meeting of the **Lehigh Valley Section.** He suggested that since slender webbed girders, recently tested in the Packard Laboratory at Lehigh, have proved able to carry a much greater load than that allowed by present specifications, new specifications which will allow a more rational and economical design will be prepared.

The following officers of the **Louisiana Section** were elected for 1960: Frank C. Fromherz, president; Francis B. Sessums, first vice-president; Roy G. Cappel, second vice-president; and Joseph T. Montgomery, III, secretary-treasurer. Directors are Hu B. Myers, A. J. Szabo, J. C. Me-

In the upper view Harry E. Myers (left), president of J. B. Converse & Company, Inc., Mobile, Ala., and second vice-president of the Alabama Section, confers with outgoing Section President John C. Clarke at the opening of the Section's two-day winter meeting in Mobile. Participating in the final sessions of the meeting are (in usual order) C. L. Cookson, speaker; J. T. Marshall, general chairman of the meeting; and J. C. Clarke.

New Kansas City Section officers, introduced at the January meeting, are (left to right) R. O. Davis, secretary-treasurer; K. E. Burkhead, director; F. E. Bleistein, first vice-president; F. A. Beets, director; W. R. Gibbs, second vice-president; Jack F. Daily, president; W. G. Fish, director; and N. L. Weis, director. Featured speaker was E. H. Swick, newly appointed region 5 engineer for the Bureau of Public Roads. His subject was the unusual problems confronting highway personnel in building and maintaining the Alaskan road system.

Lemore, David Hunter, Jr., and Wayne H. Sexton.

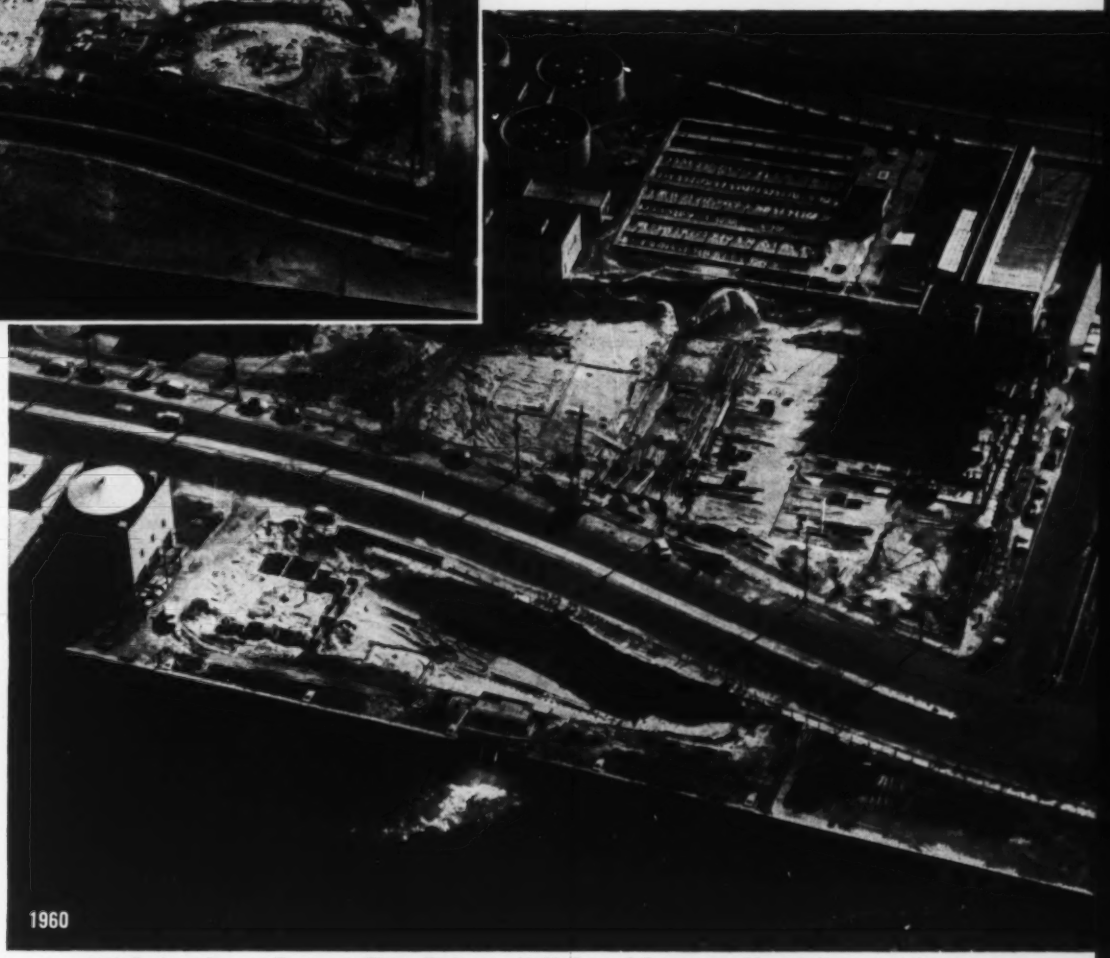
When the first space ship reaches the moon, will it find the surface covered with a 1,000-ft layer of dust, as some scientists believe, or will there be ideal soil conditions for building landing strips on which later space ships can land safely? Will there be any wind? Donald R. Lueder, president of Geotechnics & Resources, Inc., of White Plains, N.Y., at a recent **Metropolitan Section** meeting discussed a first phase study just completed by his firm for the National Aeronautics & Space Administration, whereby the answers to these and similar questions are being sought by mapping the moon in "3-D" without leaving the earth. Although no one has yet taken usable 3-D pictures of the moon, studies indicate that there is a good possibility that they can be made . . . The Section dedicated its February 17 meeting to the Newark College of Engineering, which this year celebrates the 75th anniversary of its founding. Dr. Robert W. Van Houten, president of the college, discussed the contributions made by NCE to the advancement of civil engineering education.

(*Continued on page 88*)

dried then...

dried again...by GRIFFIN

1950



1960

1950 Project: Sewage Treatment Plant, Rockaway, N. Y. *General Contractor:* Merritt-Chapman & Scott Corporation
1960 Project: Addition to Sewage Treatment Plant, Rockaway, N. Y. *General Contractor:* D. Fortunato, Incorporated

UNBRACED COFFERDAM MAINTAINED 30′ BELOW BAY... WELLPOINTS INSTALLED UNDER STRUCTURES AND STREET

Unusual features marked both predrainage operations at this large wet site. On the first job, the dewatering scheme permitted construction of a cofferdam 30 ft below Jamaica Bay – without cross-bracing.

On the "encore" performance, Griffin engineers designed the procedure to tunnel header line under structures, thus eliminating costly interruptions in plant operations. Well-points were also installed under the street, to work throughout the entire pumping operation without "tuning."

All problems were solved on both jobs as Griffin wellpoint systems continuously pumped 4 to 6 million gals per day.

Try Griffin service on one of *your* wet jobs–you'll want it for all of them.

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25th YEAR

NOW! A NEW CONCEPT
IN COMPUTER DESIGN
SETS A NEW STANDARD
OF VERSATILITY AND VALUE!

THE FULLY-TRANSISTORIZED

RPC-4000
ELECTRONIC
COMPUTING
SYSTEM

The RPC-4000 is a new, fully-transistorized electronic computing system with the largest memory, greatest problem-solving capacity and flexibility in the low- or medium-priced field. It is the latest member of a growing family from the people whose LGP-30 has become the world's leading small-scale computer.

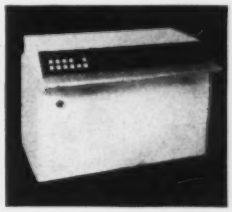
Wide range of applications: the RPC-4000 has been designed for engineering, scientific, business data processing and management control functions. Such jobs as product and process design, statistical analysis, research, inventory control, payroll and sales analysis are all well within its capabilities.

Easy to use: the RPC-4000 is simple to program and operate. Royal McBee compiling and translating routines allow even non-technical personnel to obtain maximum results. Versatile command structure gives programming speed and flexibility.

Available at low cost: high capacity, flexibility and ease of operation make the RPC-4000 the outstanding computer value on the market today.

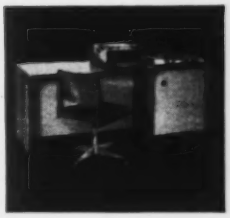
Minimum operating costs: the RPC-4000 requires no site preparation or special maintenance. It is powered from any ordinary wall outlet.

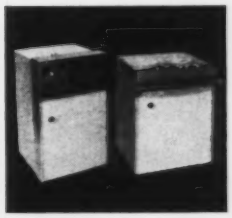
Continuing assistance: users benefit from free training, an information exchange service, and library of programs.



Heart of the RPC-4000 system is a new transistorized computer with advanced design concepts that provide substantial computing speed and capacity in a low-cost unit. Magnetic memory drum stores *8008 words*. Operating speeds are as high as 230,000/minute.

Standard input-output is a tape typewriter system which includes a Royal electric encoding-decoding typewriter complete with desk and chair, plus a tape punch-read console. Read speed is 60 characters/sec., punch speed 30 characters/sec. Typewriter, punch and reader may be interconnected in any combination for both on-line and off-line operations.





A new 500 character/sec. photoelectric tape reader and a 300 character/sec. punch are available as optional input-output equipment. A magnetic tape unit and a line printer will be available soon. As many as 17 input-output devices (60 with minor modification) may be connected on-line to the basic system. All peripheral equipment is under automatic program control of the computer.

Royal Precision Corporation

Royal Precision is jointly owned by the Royal McBee and General Precision Equipment Corporations. RPC-4000 sales and service are available coast-to-coast, in Canada and abroad through Royal McBee Data Processing Offices. For full, detailed specifications on the new, transistorized RPC-4000, write **ROYAL McBEE** data processing division, Port Chester, N.Y.

Committee chairmen in charge of the Texas Section's spring meeting to be held in Midland, April 21-23, gather for a pre-convention planning session. Shown are (front row, left to right), E. T. Shahan, Henry E. Nunn, R. F. Carroll, Ken Short and Loren Stiles; (back row, left to right), C. W. Ellis, Wendell Westerfield, Mrs. D. J. Lewis (co-chairman of Ladies Activities), Mrs. M. T. Rowland (chairman of Ladies Activities), J. F. Ross, W. Weaver and D. J. Lewis. West Texas Branch will be meeting host.

Pittsburgh Section honors the Robert A. Cummings, father (left) and son (right), on the occasion of the junior Mr. Cummings becoming a life member. Both men were presented to President Marston (center), at the annual dinner for new Life Members. President Marston spoke on Local Section activities.

Members of the Northwestern Branch of the Indiana Section held their annual meeting on January 13. Past president A. P. Arndt (second from right) poses with the Branch's new officers (left to right), R. O. Albright, vice-president; W. W. Webb, president; and Ed Gedrich, secretary-treasurer. Guest speaker was F. K. Goodell, chief engineer of the American Bridge Division of the U. S. Steel Corporation, whose topic was high strength steels in bridges.

New **Michigan Section** officers were elected at the Section's recent annual meeting. Stuart B. Maynard was chosen president. Serving with him are Robert B. Harris, first vice-president; Austin J. Miller, second vice-president; and Creighton C. Lederer, secretary-treasurer. Clem G. Merriman and Franklin H. Chapin are the directors . . . At its February meeting the Section heard Frank Firnschild, of the Advertising Division at the Detroit Edison Company, present an illustrated lecture on the "Renaissance of a City."

The ASCE Executive Committee and Director Don Mattern were guests of honor at the **Nashville Section's** December meeting. The main address was given by National President Frank A. Marston. Vivid color slides accompanied his talk on the beautification and purification of water in the Washington, D.C., area. Present at the meeting were Messrs. White, Jackson and Shackleford, of the Vanderbilt Student Chapter, recipients of the Section's prizes of one-year paid membership in the Society.

Harold L. Aitken, director of the District of Columbia Department of Highways and Traffic, spoke on metropolitan area highways at a well attended January meeting of the **National Capital Section.** Mr. Aitken said that it would be a very serious matter to cut any interstate funds for freeways in urban areas, the area in which 46 percent of all traffic occurs, and from where more than half of the tax revenue is drawn.

The annual meeting of the **Nebraska Section,** held on January 20, unanimously elected Lawrence E. Miller as president; John W. Cramer as senior vice-president; and Sidney L. Price as junior vice-president. The program consisted of a discussion of high strength steel productions and a film on the construction of Carquinez Strait Bridge . . . New officers for the Section's **Southwest Branch** are Jack Reed, president; Charles Wright, vice-president; and Gilbert Rollstin, secretary-treasurer.

James A. Lindsay, of the Lindsay Engineering Company, St. Paul, Minn., is the new president of the **Northwestern Section** for 1960. Robert Calton is new first vice-president, and Wallace V. Anderson, secretary-treasurer. Board members include past presidents Charles H. Prior and John Meyer.

The **Oregon Section** elected its officers for the new year at its December meeting. They are John T. Merrifield, president; Holly A. Cornell, first vice-president; F. Stewart Brown, second vice-president; and Robert L. Nordlander, treasurer. Donald J. Benson is director.

San Francisco Section life members, honored at the Section's December meeting, are Herman F. Bahmeier, W. E. DeYoung, Ulric R. Grey, Robert Andrew Hanson, S. B. Lane, Richard F. Lyman, Jr., Rheimier Ivan Meyerholz, Edward A. Nickel, Alfred Niles, Peter L. Spanne, John C. Vandermey and Niels F. Yde.

Water Power by PENSTOCK...

Craftsmanship by CB&I

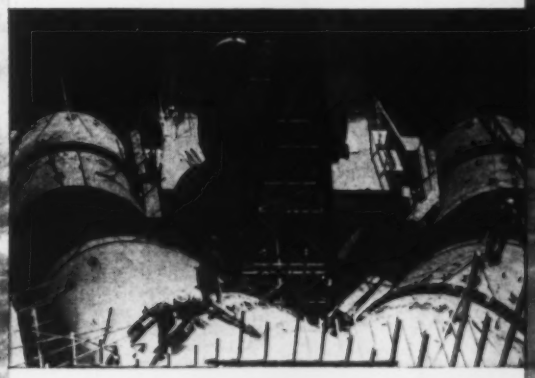
Penstocks for Mountain Home—CB&I built three, 22-ft. diam. penstocks for the Idaho Power Co.

Wherever water is diverted, harnessed or stored . . . you'll find the creative *craftsmanship in steel* of CB&I at work.

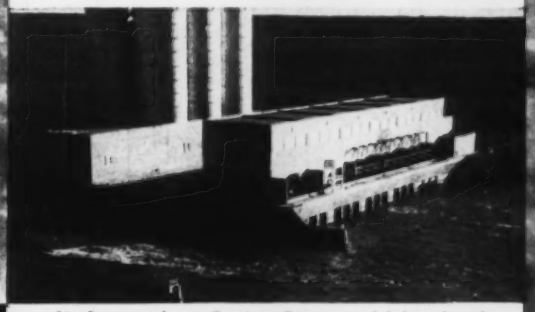
Seven decades of metallurgical know-how—under the expert supervision of engineering, fabrication and erection specialists who *know* pressure pipe and hydro-electric construction—go into each CB&I-built penstock, surge tank or power conduit.

This *single responsibility* service, backed by our four fully equipped and strategically located fabricating plants, is the reason why seasoned operators and contractors *rely on CB&I* to design, fabricate and erect to the most rigid specifications.

Write the nearest CB&I office for details. Ask for the *Blakely Mountain Dam* story.



Wye at Blakely Mountain Dam connects CB&I built power conduit, two penstocks and 149-foot high surge tank.



Six Surge tanks at Garrison Dam were fabricated and erected by CB&I to help control turbulence of the "Mighty Missouri" River. They are 65 ft. in dia. by 135 ft. high.

CB&I *Shop Fit-up of T-1 Scroll Case*—one of the largest ever built—for Noxon Rapids Dam. T-1 alloy construction of 24-ft. diam. case saved 50% in plate thickness. Reassembled and welded at site by a CB&I crew.

E60CB

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.)
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa

PLANTS: Birmingham • Chicago • Salt Lake City • Greenville, Pa. • New Castle, Del.

SUBSIDIARIES:
Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas; Chicago Bridge Limited, London; Chicago Bridge Construcoes Ltda., Rio de Janeiro

REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

360

GET POSITIVE PENETRATION AT CUTTING EDGE

The new, all-hydraulic TS-360 is the only motor scraper in the 30-yd class with double-acting bowl jacks that provide 2-way power for faster loading, more cutting control.

The TS-360's exclusive hydraulic down pressure penetrates quickly into the toughest-loading materials. Penetrating force like this—along with Allis-Chalmers original low, wide bowl—gives you fast, heaped loads every pass.

Slope-cutting is another good example! "Cornering-in" with bowl down pressure lets your operator sink his bit *when* and *where he wants* . . . lets him maintain the best cutting depth while loading. The result: Clean, accurate slopes.

Positive penetration is only one reason you'll get top performance on any size job. *Two-stage steering—forced ejection and highest apron lift—90° steer and* KON-TORK *differential* are earth-moving advantages you cannot afford to overlook.

Put this new 340-hp TS-360 to work for you. Move more dirt per dollar invested than ever before. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

KON-TORK is an Allis-Chalmers trademark.

move ahead with

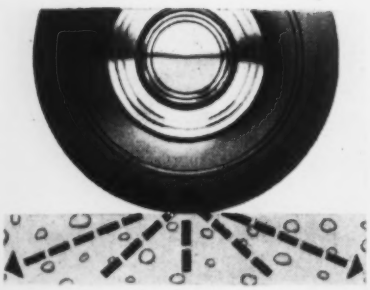
ALLIS-CHALMERS

. . . power for a growing world

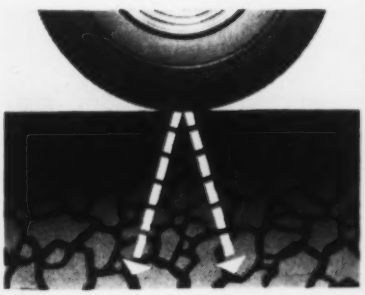
FOR HIGHWAYS WITH A SOLID FUTURE

Concrete

CONCRETE is the ...gives maximum strength



Concrete's beam effect spreads wheel weight over large area of subgrade, reduces spot pressures. Strength of material—not mass—carries the load, permitting minimum-thickness pavement.



Flexible pavement, by its very flexing effect, transmits load forces in almost direct line to subgrade. Excessive concentration of load force can be overcome only by building up pavement thickness.

Modern concrete for Kentucky's Interstate 65 south of Elizabethtown

pavement that is not flexible with minimum thickness!

Interstate System highways like Kentucky's Route 65, pictured here, call for a pavement that is solid and unyielding.

Kentucky's highway department chose concrete for this important stretch of Interstate System highway. Necessity for multiple strata construction of 2 to 3 times greater total depth was avoided.

Strength with minimum bulk is possible, of course, because concrete isn't flexible. It supports and spreads the load like a beam. Pressures on the subgrade stay permanently within safe limits.

And concrete's design efficiency assures low maintenance costs in years ahead. In fact, maintenance costs will be as much as 60% lower than for asphalt. Only concrete enables engineers to design highways to last 50 years and more.

You can see why engineers and taxpayers agree that concrete is the preferred pavement for heavy-duty highways—especially on the new Interstate System.

PORTLAND CEMENT ASSOCIATION *A national organization to improve and extend the uses of concrete*

BY-LINE WASHINGTON . . . . .

The **status and business future of many ex-military engineer officers** will be seriously affected, if Congress approves a new bill (HR 9682) that forbids such men to "sell" anything—including, presumably, engineering services—to the Department of Defense within two years of their retirement. More important yet to many engineering and contracting firms is the likelihood that the stricture will be expanded to cover other governmental agencies as well. A report of a House Armed Services subcommittee defines "selling" as ". . . all activities that bring a contractor or his representatives into contact with officials of the Department of Defense for the purpose of obtaining contracts . . . for procurement of . . . tangibles or intangibles . . ." Announced targets of the bill are aircraft and missile manufacturers, whom the author, Rep. F. Edward Hebert (D. La.) has been investigating for a long time, in his capacity as chairman of the subcommittee.

* * *

Architects have joined—though on a side issue—the battle in Washington over the use of **consultants on government construction.** What brought in the American Institute of Architects was a ruling by the Bureau of Indian Affairs that has cut off all outside architectural contracts for nearly a year. Said George Wright (of Stanley & Wright, Albuquerque, N.M.), "The claim . . . that it is cheaper to use government architects . . . preparing standardized plans . . . is false, and the reasoning erroneous. To be sure, the lure of standardized or stock plans . . . is intriguing. But the fact is that they don't work."

* * *

The speed with which the House, in mid-February, passed the huge **stream-pollution control bill** (HR 3610) is an indication of two things: Sanitation interests have done a good job of selling the need for pollution control to Congress; many Congressmen see the matter as a solid political issue, whether they can override a veto or not. As approved, the new bill is a direct slap at the President, who recommended only $20 million in federal grants for pollution control. The bill ups the annual grants (over a ten-year period) to $90 million, and the size of the federal contribution on any project to $450,000, from $250,000.

* * *

Already deeply enmeshed in **Congressional probes** (of highways, use of consultants, pollution control, etc.), the construction industry will figure heavily in still another, later in the session. Senator Estes Kefauver's anti-trust and monopoly subcommittee will look into prices of building materials, when it gets through its present probe into the drug industry and others. Special target: Glass, plumbing fixtures, concrete pipe, asbestos and gypsum.

* * *

With pollution in general occupying a lot of Congressional attention, the U.S. Public Health Service has come out with a report on a device that purportedly would cut **air pollution** caused by automobile engines. Gist of the report: The device tested is helpful, but not completely effective, won't provide the single answer, for instance, to Los Angeles' smog problems. The device, said to cost $1.99, does cut an average of 33 to 40 percent of the total hydrocarbons emitted by an engine. But it has little effect on hydrocarbons produced in the explosion of the air-fuel mixture in the cylinders; cannot destroy the olefins created in combustion; does not remove carbon monoxide or hydrocarbons produced by evaporation from the fuel system.

* * *

The **U. S. Bureau of Standards**—its delicate testing equipment increasingly disturbed by growing metropolitanism around its campus-like grounds on Connecticut Avenue—will finally start its long-planned move out of the city, under a $24 million appropriation included in the Commerce Department money bill. New site will be at Gaithersburg, Md. (about 20 miles northwest of Washington), within a few miles of the Atomic Energy Commission's controversial new headquarters at Germantown.

* * *

Waterways operators, thoroughly alarmed at prospects of toll charges against them for use of government-built navigation aids, have organized a new group to "establish a common purpose with respect to legislative and public relations activities among carriers providing service over inland waters, on the Great Lakes, and in coastal and coastwise trade." The organization will have its headquarters in Washington (at 1025 Connecticut Ave., N.W., also headquarters of the American Waterways Operators) and is headed by A. C. Ingersoll Jr., president of Federal Barge Lines, Inc. The name will be the Committee of Domestic Water Carriers.

* * *

Congressmen from the larger cities have placed over a **half-dozen bills in the legislative hopper,** seeking relief for commuter railroads and means of keeping them in operation. Most interesting is a bill by New York City's Rep. Herbert Zelenko, which would permit commuters to conduct the cost of any fare rises from their income tax payments. And while Congressmen sought to continue railroad operations, the Virginia State Highway Department announced it was considering buying the right of way of the Washington & Old Dominion Railroad (which runs from Washington right through the new Dulles International Airport, through populous Alexandria and Falls Church) as a right-of-way for a new highway.

* * *

Federal money continues to pour into the effort to increase **teaching of the sciences—including engineering**—in the nation's schools. The Department of Health, Education and Welfare (Office of Education) said it has thus far (since the beginning of fiscal year 1959) made $79.4 million available to elementary and secondary schools in all states and territories to improve teaching science, mathematics, and foreign languages; has another $30-odd million to spend for this purpose before July 1, 1960. And the National Science Foundation has announced that it will spend $21 million this year, in the form of grants, to pay tuition costs of some 18,000 high school and college instructors participating in Summer Institutes in 265 educational institutions, for advanced courses in engineering, other sciences, and mathematics.

Indiana builds 1,500 new bridges... 1,087 miles of new Interstate Highways

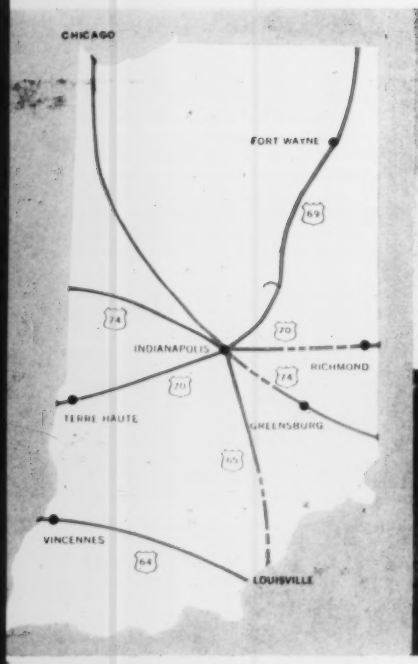
Upper left–USS Structural Steel, shown here in support of the bridge deck, is one of the most economical of all load-carrying materials. It has great strength, permits higher allowable working stresses, and is easily and quickly fabricated in all kinds of weather, substantially reducing construction costs.

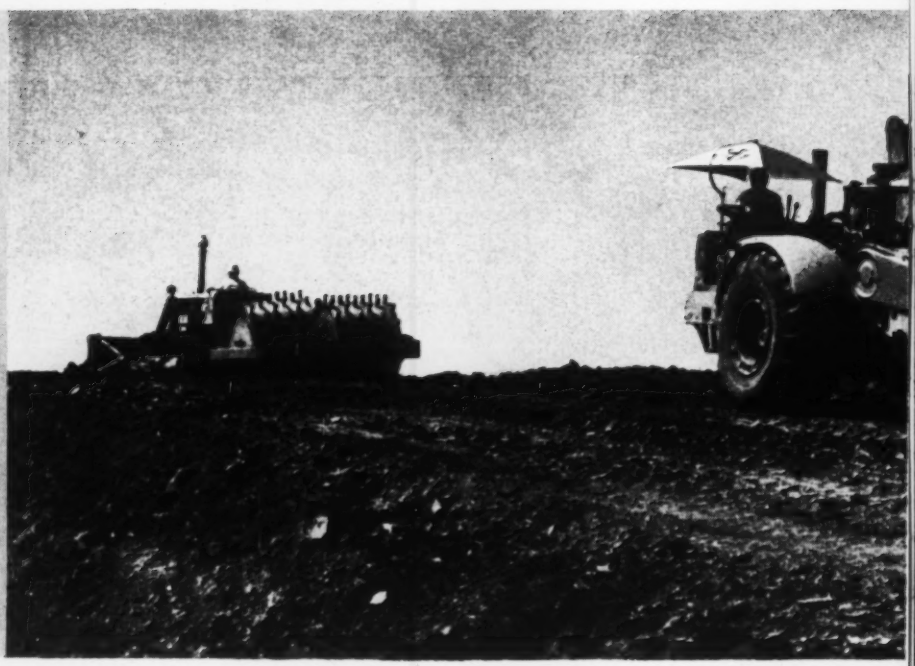
Upper right–Tractor treads take a terrific beating day in and day out. USS Special Rolled Sections are produced to high-quality standards and can stand up to heavy punishment for a long time without replacement, cutting ultimate construction costs. In the background, USS TIGER BRAND Wire Rope lowers a crane load; USS DI-LOK Reinforcing Bars will aid in providing strong, stable support for a new bridge.

Left–More than two million tons of Blast Furnace Slag were used in constructing the western section of the Indiana East-West Toll Road. Air-cooled, crushed-and-screened slag was used as aggregate in the concrete column bents and pavement of this structural steel elevated roadway; and air-cooled, run-of-bank slag was used for erosion control along the banks of the Calumet River.

See inside

Indiana constructs new



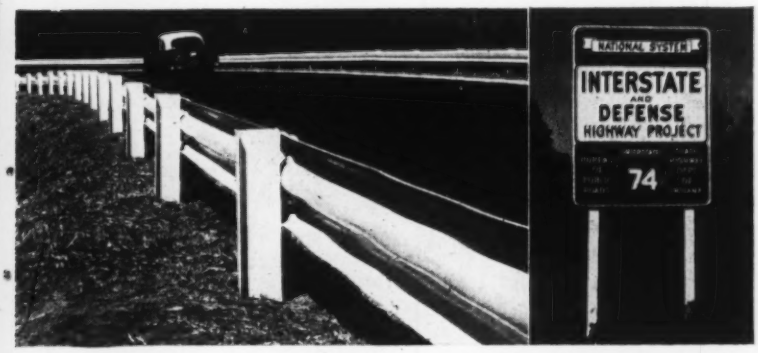


This map shows the general location of Interstate Highways in Indiana. Dotted lines indicate completed highways. Almost all the main routes go into Indianapolis. It has more Interstate Roads leading into it than any other city in the U.S.

Interstate roads and bridges

with help of products from U.S. Steel

Mammoth road-building machines like these must be strong. For strength plus lightweight that increases operating efficiency, strategic parts of this equipment are made with USS High-Strength Steels—USS MAN-TEN and USS TRI-TEN. Control cables are of dependable USS TIGER BRAND Wire Rope.



Highway safety begins with preliminary road design. From a safe, smooth surface (concrete made with UNIVERSAL ATLAS Cement) to strong, long-lasting AmBridge Guard Rail, USS can be your single source of supply. Included in the complete line of USS highway safety products are tubular poles for lights, galvanized steel guard cable, galvanized steel sheets, USS VITRENAMEL enameled sheets for signs, and CYCLONE Fence.

Left—Indiana's many bridges like the one here on Interstate Route 65 are built with a variety of highway products such as: USS Structural Steel, USS DI-LOK Concrete Reinforcing Bars, UNIVERSAL ATLAS Cement. USS Steel H-Piles support piers.

Write for the *free* 54-page booklet, "Keep Our Roads On the Go." You'll find all the United States Steel products and services that will help you cut costs and speed operations in highway construction. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

Construction for the Interstate Highway Program is moving rapidly in Indiana. 1,087 miles of Interstate roads and 1,500 bridges are scheduled. Of these, 817 miles of new highways and 103 bridges are under development. More than 165 miles of new roads and 453 new bridges have already been completed or are under construction, not including the Indiana Toll Road. Over $80,575,000 is being spent on the Program this year. The work is under the direction of John Peters, Chairman, Indiana Highway Commission, and G. M. Foster, Executive Director of the Indiana Highway Department.

Many kinds of highway products are needed to build Indiana's roads . . . and U. S. Steel offers a *complete* line of these products: Structural carbon steel, high-strength and constructional alloy steels for bridges; steel H-piles, sheet piling and tubular piles for bridge foundations; drainage products; cements for all types of concrete construction; slag; reinforcing bars and welded wire fabric; wire rope, cable, tubing and special steels for construction equipment; fence, beam and cable guard rail, steel sheets for signs . . . and dozens more.

USS, ATLAS, CYCLONE, DI-LOK, MAN-TEN, TIGER BRAND, TRI-TEN, UNIVERSAL and VITRENAMEL are registered trademarks.

United States Steel

USS

The highway market is served by United States Steel, Pittsburgh, Pa., and the following divisions: American Bridge Division, Pittsburgh, Pa., American Steel & Wire Division and Cyclone Fence Department, Cleveland, Ohio; Columbia-Geneva Steel Division, San Francisco, Calif.; Consolidated Western Steel Division, Los Angeles, Calif.; National Tube Division, Pittsburgh, Pa., Tennessee Coal & Iron Division, Fairfield, Ala.; Universal Atlas Cement Division, New York; United States Steel Supply Division, Steel Service Centers, Chicago, Illinois.

OKLAHOMA PROJECT I-205 (5) Interstate Route 40

Oklahoma builds to last...with "DEEP-STRENGTH" Asphalt pavement

• Hot-mixed—hot-laid Asphalt base promises outstanding service life.
• Design overcomes problems of plastic subsoil and short aggregate supply.

Down in Oklahoma, they've just completed a beauty . . . a new *Deep-Strength* Asphalt pavement that includes many features of The Asphalt Institute's Advanced Design Criteria.

And it won't be the last. That's for sure.

Just take a look at the construction (right) and cross section (below). Notice that precepts of new *Deep-Strength* Asphalt design are incorporated...heavy-duty Asphalt concrete surface course . . . heavy-duty Asphalt base . . . Asphalt primed subbase . . . wide double-sealed Asphalt shoulders (on Asphalt base) . . . heavy compaction . . . good drainage.

When designed like this — for *Deep-Strength* . . . Asphalt pavements will carry the heaviest traffic loads without distress . . . with minimum maintenance cost. Witness the New Jersey Turnpike. Witness also *Deep-Strength* Asphalt city pavements built more than 60 years ago and still in service.

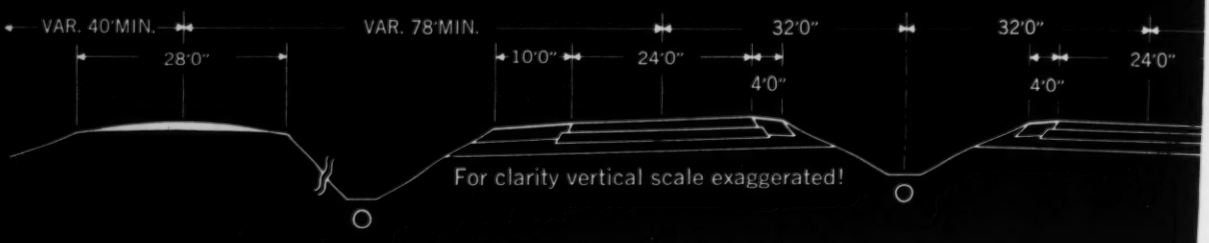
Save money, too

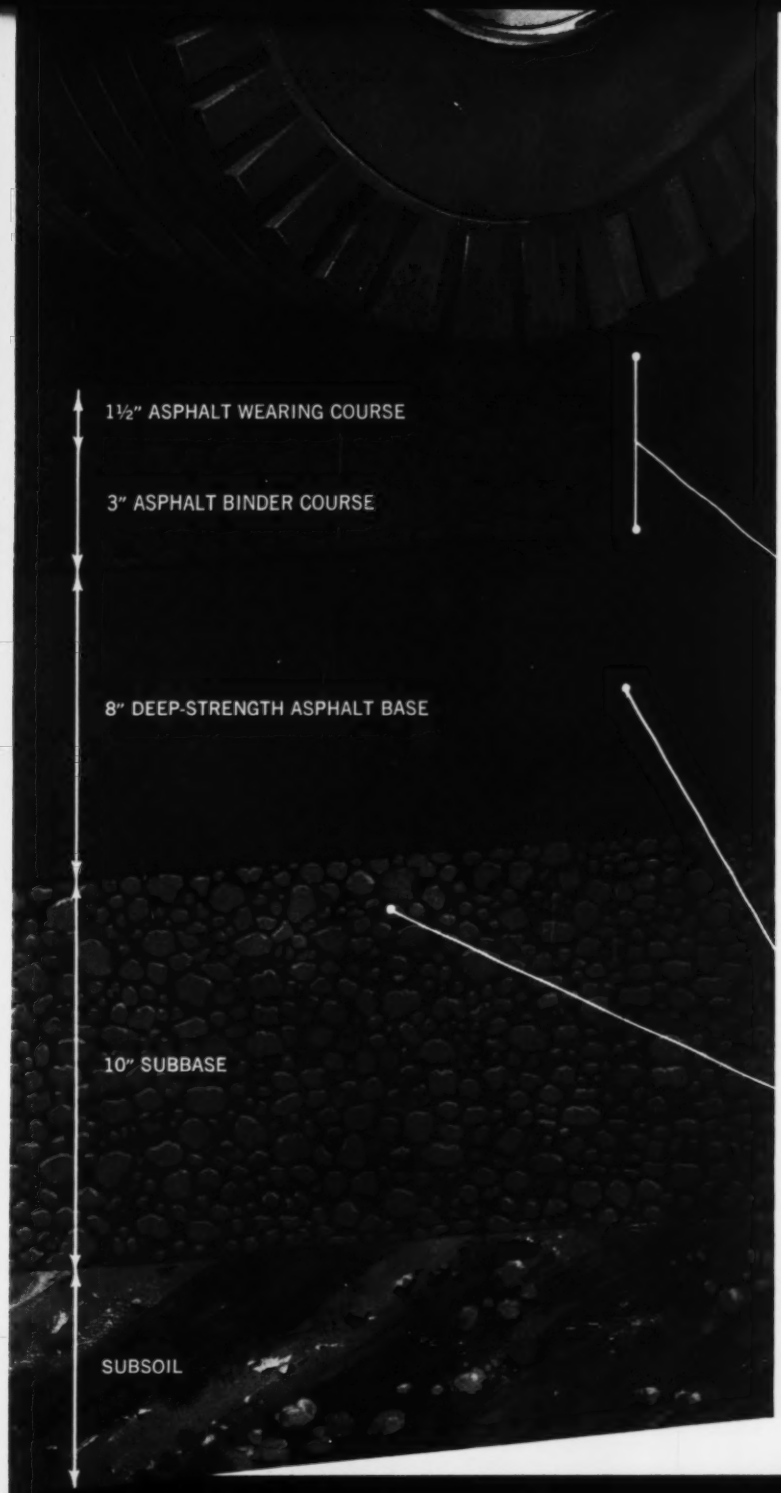
Surprising as it seems at first glance, modern low-maintenance, *Deep-Strength* Asphalt pavements often cost less to build than Asphalt pavements designed to other standards. That's because the Advanced Design Criteria permit inexpensive Asphalt base to be substituted, within limits, for the more expensive Asphalt concrete surfacing. And also because total pavement thickness can often be reduced by several inches.

New Handbook

Now on the presses is a new edition of The Asphalt Handbook. It incorporates all the Advanced Design Criteria for highways implied by the term *Deep-Strength* Asphalt Construction. Copies soon will be available at The Asphalt Institute office serving your area.

DEPRESSED MEDIANS ASSIST FREE DRAINING. Note also the Asphalt shoulder construction. These two measures alone can substantially

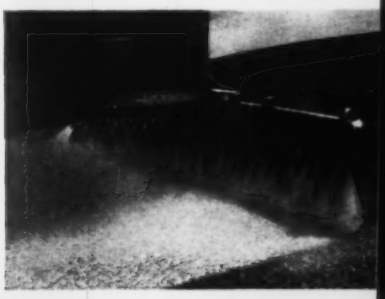




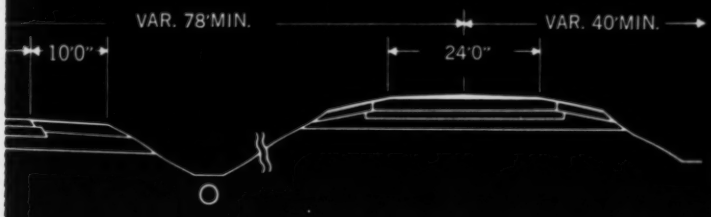
4½-INCH ASPHALT CONCRETE SURFACE takes heaviest traffic, deicing salts without distress. Lane markings show up better day or night, wet or dry.

8-inch sand-Asphalt base provides deep strength . . . excludes moisture, insures smoother riding surface under heaviest traffic.

ASPHALT PRIME COAT SEALS SUBBASE . . . insures bond with overlying Asphalt base.



lengthen pavement life.



Ribbons of velvet smoothness . . . ASPHALT paved Interstate Highways.

THE ASPHALT INSTITUTE

Asphalt Institute Building, College Park, Maryland

NEWS BRIEFS . . .

Value of January Construction Above 1959 Level

The value of new construction put in place in January 1960 amounted to $3.7 billion, according to preliminary estimates of the Bureau of the Census of the U.S. Department of Commerce. This represented a drop of 8 percent from December 1959, but an increase of 1 percent above the January 1959 level. The decline from December to January was less than the normal seasonal change for that period.

Total new private construction expenditures this January amounted to $2.7 billion, 10 percent less than the $3.1 billion spent in December, but 6 percent above the January 1959 level. Most types of private construction decreased by less than the normal December-to-January change. Nearly all private categories showed greater expenditures in January 1960 than in January 1959. The major exception was new residential dwelling units, for which expenditures in January 1960 were 3 percent below the January 1959 level.

Total new public construction this January amounted to $1.0 billion, 1 percent less than in December 1959 and 12 percent below January 1959. All types of public construction with the exception of expenditures for water systems and public service enterprises, showed either a contraseasonal increase in expenditures in January or declined by less than the amount normal for the season.

For highway construction the sharp rise in the estimates of the seasonally adjusted annual rate of expenditures from December 1959 to January 1960 probably substantially overstates the increase that actually occurred since it now appears that the estimates for the final months of 1959 were too low. The necessary revisions will be made in the 1959 data for highway construction as soon as they can be calculated and published. Estimates for September, October, and November 1959 reflect the results of special surveys of a sample of builders and contractors undertaken to obtain information about any effect the steel shortages may have had on construction work done in those months. Results of these surveys have been applied to the figures derived from the normal estimating procedures. No special survey was made on the effect of the steel strike after November, because of the resumption of production in that month.

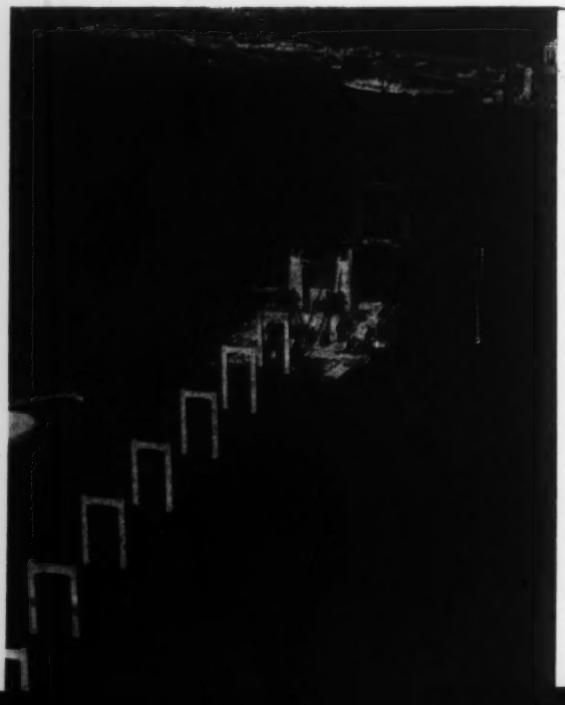
With the exception of the special surveys mentioned here, these monthly estimates are not based on direct measurements. Primarily, they are derived by applying standard progress patterns (which reflect normal seasonal movements) to the value of contracts awarded prior to the current month.

Summer Courses For Civil Engineers

A two-week program in **Estuary and Coastline Hydrodynamics**—intended to meet the needs of engineers engaged in the design and development of all types of marine structures in which gravity wave action and tidal phenomena are important—will be given at the **Massachusetts Institute of Technology** (Cambridge 39, Mass.), June 20-July 1. A general review of the theory will be given, including the most recent results of experimental analytical research. Topics include: generation and transformation of waves, damping by boundary layer action, wave refraction and diffraction, resonant conditions in harbors, interaction of waves and marine structures, coastal currents, sediment erosion and deposition, tidal dynamics of estuaries and inlets, saline and fresh water interaction, steady and unsteady diffusion processes in estuaries, coastal and tidal models.

The lectures will be given by the staff of the Hydrodynamics Laboratory of the Department of Civil and Sanitary Engineer and will be coordinated with presentations by other experts in the field. Dr. Arthur T. Ippen, F. ASCE, Professor of Hydraulics, will be in charge of the program.

A helpful course for sanitary engineers and others interested in **water pollution control work** will be offered at the **Robert A. Taft Sanitary Engineering Center,** Cincinnati, Ohio. The course will be



Throgs Neck Bridge

Ready for Cable Spinning

Connecting the Bronx with Queens at the eastern edge of New York City, Throgs Neck Bridge is being pushed to completion early next year. In the foreground is the Queens anchorage with the construction plant of J. Rich Steers Inc., and Frederick Snare Corp., joint contractors for the anchorage. This equipment was used to build the world's record-size anchorage, 146 x 226 ft in plan and sink it to a depth of 135 ft by dredging through 77 wells. (See "Civil Engineering," October '59, Vol. p. 706). Bethlehem Steel Co. erected the towers, and the American Bridge Division of the U.S. Steel Corp is putting the superstructure on the suspended span. Ammann & Whitney of New York are engineers on the main span; E. Lionel Pavlo designed the approaches. The owner is the Triborough Bridge and Tunnel Authority.

given June 20-July 1 by the U.S. Public Health Service's Water Supply and Pollution Control Training Program. Applications should be addressed to Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

Fundamentals of the application of biology to analysis of water pollution problems will be stressed. Laboratory work will feature techniques for handling and identifying aquatic organisms and interpreting their significance. Lecture subjects will include marine and estuarine effects of pollution, treatment of wastes (stabilization ponds, anaerobic, and other methods), problems of industrial pollution, and water quality management and criteria.

Sea Water Conversion Plant in Operation

The first general purpose sea water conversion plant on the Pacific Coast has just been placed in operation by the Southern California Edison Company at its steam electric plant on Mandalay Beach near Oxnard, Calif. Wide interest has been expressed in the California project not only because it employs a new distillation principle, but also because it will be the subject of an intensive three-year research program. The experimental plant is the first of its kind in the country to be used in conjunction with an existing steam-electric generating station.

The unit, which has a daily capacity of 100,000 gal, was designed, engineered, and manufactured by Cleaver-Brooks Special Products, Waukesha, Wis. Cost of the unit and installation was reported in excess of $250,000. The plant utilizes steam, which has passed through the station's turbine and is extracted for use in the evaporator plant. As a result it provides relatively inexpensive heat.

Experience and data derived from experiments with the pilot plant are expected to provide technical and cost information leading to the eventual construction of saline water plants with capacities of from five to ten million gallons a day of potable water.

Improved Sales Volume Forecast at AED Meeting

A feeling of extreme optimism regarding business conditions in the "Soaring 60's" was expressed by the 4,000 representatives of manufacturing companies and distributor firms attending the recent 41st annual meeting of the Associated Equipment Distributors in Chicago. While the year ahead is expected to bring a higher volume of construction machinery sales in all parts of the country, retiring President F. J. Fitzpatrick warned that the individual dealer's volume and profits will reflect local conditions.

New Peace River Bridge Is Opened

The new Peace River Bridge is constructed on the same alignment as the suspension bridge that collapsed due to sliding of an anchorage (December 1957 issue, page 92). It is a key structure in the Alaskan Highway, and is located near its southern terminus in British Columbia.

The new bridge is a continuous cantilever steel deck truss structure, consisting of five long truss spans and one short stringer span. Its total length is 2,335.9 ft between end bearings. The bridge carries an open grid deck roadway, 26 ft wide inside curbs and two 5-ft sidewalks. The deck has a uniform slope of 3 percent from north to south abutment. The bridge is designed for H25 S20-44 live load. Only the south anchor block of the old suspension bridge, raised and lengthened, is included in the new structure. Other parts have been or will be demolished.

Footings of the four river piers are placed some 30 ft below the prevailing bottom of the river and are cut at least 10 ft into the hard shale. All piers are supported on steel piles, 8WF48, which were placed in 12 to 14-in.-dia holes drilled in shale and filled with concrete. The piles extend to a depth of 20 ft below the pier footings, thus spreading the load to the intersected layers of shale, which are fissured and contain water-bearing strata. The design load for each pile is 65 tons. There are from 98 to 105 piles under each of the river piers.

Pier No. 5 is located on the high north bank, 70 ft away from the top limit of the disastrous 1957 slide. This pier is supported on 40 steel piles placed in concrete-filled holes similar to those under the river piers. Vertical drain holes, 12 in. in diameter, up to 70 ft deep and filled with gravel were provided to intersect water bearing strata in the shale below foundations and relieve pore pressure.

The lengths of the truss spans, from the south abutment, are 347.4 ft, 445.5 ft, 445.5 ft, 470.5 ft and 552.5 ft. The stringer span between piers and north abutment is 70 ft long.

Spans one and three include 247.5-ft-long suspended trusses, supported by trusses cantilevered from spans two and four. A special feature of this bridge is span five, 552.5 ft long, which includes a 418-ft-long suspended span and "jumps over" the unstable slide zone on the north shore, thus eliminating the need for any support in that area.

All truss joints are made with high tensile steel bolts. The specifications called for subpunching and reaming of all holes in all members carrying calculated stresses. This was requested in order to reduce the possibility of the development of brittle fracture at the low temperatures to which this structure will be subjected.

The bridge was designed as the combined effort of a Board of Engineers appointed by the Department of National Defence, under the chairmanship of the late Dr. P. L. Pratley, consulting engineer of Montreal, assisted by A. B. Sanderson, A. B. Sanderson & Co., Ltd., Victoria, B. C.; H. H. Minshall, H. H. Minshall and Associates, Vancouver; and L. G. Grimble, Stanley, Grimble & Roblin Ltd., Edmonton, Alberta.

The substructure was installed by Vancouver Pile Driving and Contracting Ltd., working with Manning Construction Ltd., Vancouver. The superstructure was fabricated and erected by the Dominion Bridge Company Ltd., Vancouver.

[*Editor's Note:* For this information CIVIL ENGINEERING is indebted to Col. J. Blair, Director of Works, Department of National Defence of the Canadian Army.]

Dedication of a new 150-ft-high ultramodern control tower took place at Newark Airport on January 18. Built by the Port of New York Authority, the $1,500,000 control tower is the fourth in the 31-year history of the airport. It will be used by the Federal Aviation Agency in controlling air and ground aircraft movements at the busy New Jersey terminal. Located near the center of the 2,300-acre airport, the tower affords controllers the best possible view of runways, taxiways, and ramp areas. The new facility has a circular ground floor, 78 ft in diameter, which contains FAA offices and building utilities. A 117-ft concrete shaft rising from the base of the tower encloses an elevator, stairways, and equipment conduits. At the 65-ft level, three floors containing about $1,000,000 worth of federal air traffic control equipment are cantilevered out to a 37-ft overhang.

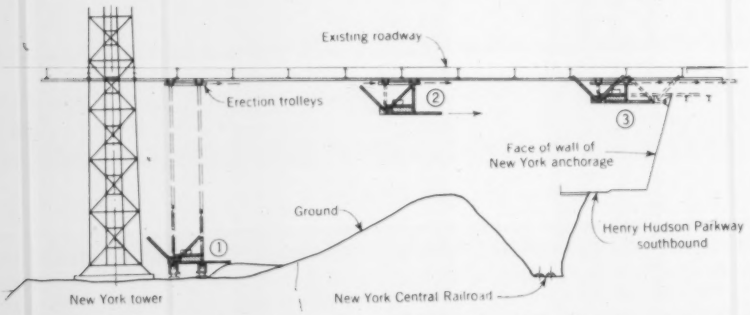
Newark Airport Opens Ultramodern Control Tower

Second Deck of George Washington Bridge Placed in Sections

The first of seventy-six structural steel sections for the six-lane lower deck of the George Washington Bridge was raised into position, 200 ft above the ground, on January 18. The section, which was lashed with steel cables under the eight-lane roadway, was placed just east of the New York tower of the bridge. The huge 220-ton steel deck assembly—90 ft long, 108 ft wide, and 30 ft deep—was lifted by four powerful erection trolleys. These are traveling platforms complete with hoisting engine, power tools and other equipment suspended from temporary tracks under the existing span of the great bridge. The deck assembly was placed in its permanent position at the New York end of the bridge to form the first steel section for the second deck.

The plan for erecting the lower deck from below was worked out by engineers of the Port of New York Authority and the Bethlehem Steel Company, the contractor on the steel work. The method permits construction to proceed without interfering with traffic on the existing span. About 95,000 vehicles pass over the bridge each day. The second deck will double its capacity.

The riveting of the 13,875 tons of structural steel for the second deck will be completed by early 1961. The entire project, including the second deck and the expanded Manhattan and New Jersey approaches, is scheduled for completion in 1962. The project will be $183,000,000—over three times the cost of the original bridge.



Erection of 220-ton steel sections for the second deck of the George Washington Bridge will take place in steps. Trolleys, suspended from the present deck, raise the sections and then move them into position.

AWWA Nominates Officers And Awards Honors

C. F. Wertz, F. ASCE, director of the Department of Water and Sewers, Miami, Fla., has been nominated president of the American Water Works Association for 1960-1961. The other nominees are John W. Cramer, F. ASCE, partner in the Lincoln, Nebr., firm of Fulton and Cramer, for vice-president; and William J. Orchard, retired general manager of Wallace & Tiernan, Inc., of Belleville, N. J., who will serve his fourth term as treasurer. The nominations were announced at the annual meeting of the association's board of directors, held in New York the end of January.

New elections to honorary membership in the AWWA are Raymond J. Faust, secretary of the American Water Works Association; Edward R. Stapley, dean emeritus of engineering at Oklahoma Agricultural and Mechanical College; and Paul Weir, manager of the Atlanta (Ga.) Water Department. All are Fellows in ASCE.

The John M. Diven Memorial Medal goes to E. Shaw Cole, F. ASCE, vice president and chief engineer of the Pitometer Company, Engineers, New York City. It is awarded annually to the AWWA member who has rendered the most outstanding service to the organization during the year. Winners of publication awards include Fred A. Eidsness, F. ASCE, and Earnest F. Gloyna and Murray B. McPherson, Members ASCE.

The new slate will take office and honors will be presented during the AWWA Annual Conference to be held at Bal Harbour, Fla., May 15-20.

Equipment Shipped for Bangkok Electric Plant

A huge generator stator for Thailand's first modern, high-efficiency steam power plant was shipped from the Port of Philadelphia early in February. The Yanhee Electricity Authority, an agency of the Thai government, will install a complete 75,000-kw generating unit, valued at about $10 million, supplied by the Westinghouse Electric International Company. The power plant, scheduled for completion early in 1961, will serve Bangkok, the capital city, which has a population of one million.

According to R. L. Jeans, products vice president of Westinghouse International, the power station will operate on lignite, a low-grade domestic coal. All of Thailand's present steam and diesel electric generating equipment requires expensive imported coal or oil.

The Export-Import Bank is financing the $14 million project. Included in the mechanical apparatus are a Babcock & Wilcox Company boiler and products of 100 other American suppliers. The Kuljian Corporation of Philadelphia is consulting engineer.

Aluminum Output Rises in 1959

Aluminum output of the combined facilities of the six big U. S. producers was high in 1959—some 1,950,000 tons, or about 25 percent over production in 1958. Five new monthly production records were set as the nation's potlines were operated at near capacity levels. Installed capacity for the 21 reduction plants in the country stood at 2,336,083 tons in September, and additional facilities under construction will boost the nation's total capacity to 2,604,750 tons by the end of 1961.

Shipments of all classes of semifabricated aluminum products were substantially higher in 1959 than in the previous year, according to U. S. Bureau of Census statistics. The light metal is invading the building field, and the construction industry took about a quarter of all wrought products shipped. An indication of its growing popularity as a building material comes from Los Angeles where the use of aluminum for commercial and residential construction was recently authorized by the Los Angeles Building Department. Automotive uses of aluminum are also on the increase, with the average 1960 automobile using 13 percent more aluminum than the 1959 models.

Clarify Your Position For Census Bureau

The 1960 Population Census will be conducted, starting April 1. Every fourth household will be asked to answer the question, "What kind of work is he doing?" for each person 14 years of age or older.

To assure that the statistics on scientific and engineering manpower be developed as accurately as possible, the U. S. Census Bureau has asked the Society to pass along to members a reminder that this question on occupation should be answered completely and precisely. The entry should consist of at least two words in most cases.

Suggested examples of acceptable entries are:

Civil engineer
Civil engineer, inspection
Consultant engineer, civil
Design civil engineer, highway
Estimating civil engineeer
Field civil engineer
Project civil engineer
Testing engineer, civil

N. Y. Plans Study of Hudson Waterfront

Ebasco Services has been invited by the New York City Board of Estimate to make an overall redevelopment study of a five-mile stretch of the Hudson River waterfront from the Battery to 72nd Street. The study will include surveys of waterfront and urban traffic flow in an attempt to integrate waterfront improvements with the projected double deck for the West Side Highway and crosstown expressways. Extension of pier rooftop automobile parking will be considered, as will redevelopment of the Produce Market piers. With an eye for the 1964 World's Fair, the study will also include a thorough reappraisal of passenger terminal facilities.

The study is being made at the recommendation of the Marine and Aviation Department. Most of the city's prominent civic and commercial groups will be consulted by Ebasco in the course of the study. Working with the redevelopment team will be Dr. Herbert J. Dorau, chairman of the Public Utilities and Transportation Department of New York University; the New York consulting firm of Moran, Proctor, Mueser and Rutledge; and the architectural firm of Eggers & Higgins.

Eighth Pan American Highway Congress

With the opening of the Pan American Highway as far as the Panama Canal expected in the near future, the forthcoming Eighth Pan American Highway Conference will devote major attention to ways and means of completing the entire route of the great "Avenue of the Americas." The conference will be held in Bogota, Colombia, May 20-29. The official conference languages will be English, French, Portuguese, and Spanish.

A special invitation to the congress is extended to U. S. highway engineers by the Hon. Virgilio Barco Vargas, Minister of Public Works and Development of Colombia and chairman of the organizing committee for the conference. Engineers planning to attend may obtain additional information from Francisco J. Hernandez, Permanent Secretary, Pan American Highway Congress, Pan American Union, Washington 6, D. C.

New Offstreet Parking Plan for New York City

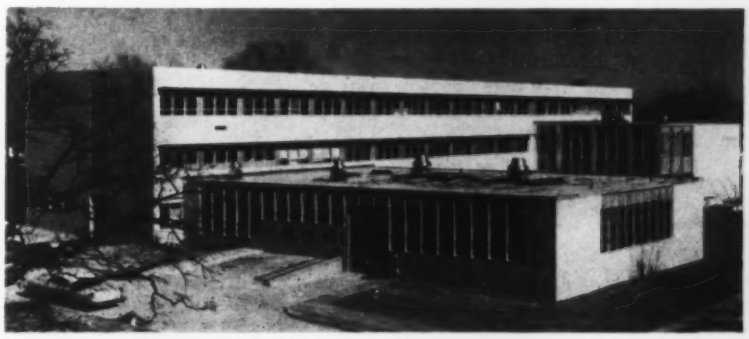
To encourage shopping in midtown Manhattan, New York City Traffic Commissioner T. T. Wiley, F. ASCE, has recommended to Mayor Wagner a program to provide offstreet parking for nearly 10,000 vehicles in the congested area between 22nd and 59th Streets and Second and Eighth Avenues. The garages would be operated to accommodate shoppers and other short-time parkers at a fee of 25 cents an hour. For longer periods of parking the fee will rise on a sliding scale. Fourteen of the proposed garages would be self-parking, and one mechanical.

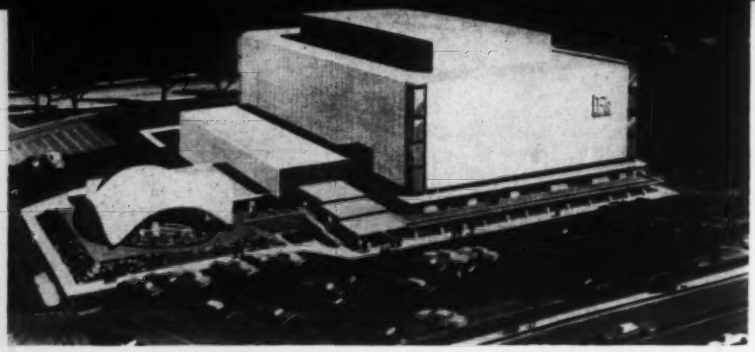
The recommendation is the result of a comprehensive study and analysis made by the consulting engineering firm of Charles E. DeLeuw and Traffic Department engineers. The engineers estimate that the facilities will serve over 6,500,000 motorists annually. The land and construction cost of $52,500,000 will be liquidated from income over a thirty-year period.

In announcing the program, Commissioner Wiley warned that people will take their shopping and business out of the city if adequate "parking facilities in the right places" are not made available to them.

University of Missouri Has New C.E. Building

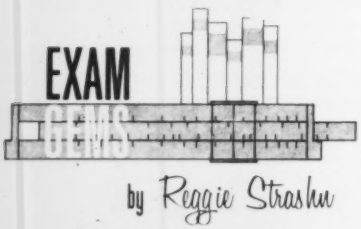
Civil Engineering Department of the University of Missouri's School of Mines and Metallurgy is occupying a new million-dollar Civil Engineering Building. The impressive new building, largest on the campus, will provide 47,350 sq ft of floor space. It has 18 classrooms, four design rooms, and five large laboratories with up-to-the-minute facilities for research and testing. An unusual feature is the computer center. Of special interest, also, is the Needles Conference Room, which was furnished by New York City Consultant Enoch R. Needles, Past-President of ASCE and a 1914 graduate of the Missouri School of Mines. The building will be officially dedicated on April 8.





Dallas to Have Construction Industry Center

A $3,000,000 center for the construction industry, first of its kind in the country, is planned for Dallas. Work on the 253,895-sq ft center will begin this spring, with completion scheduled for 1961. The project, designed by Dallas architect George L. Dahl and known as Fleetwood Square, will be a convenience for engineers, architects, contractors, and others who specify and buy. In addition to the large office-exhibit building, the project will include an auditorium and banquet hall, technical library, and 126-car underground garage. Some 150 national manufacturers of building materials will maintain year-round displays of their products in the center.



R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 8 asked Colorado examinees to determine the maximum and minimum intensities of pressure on the base of a trapezoidal concrete dam 10 ft wide at the crest, 16 ft wide at the base, 40 ft high, impounding water 36 ft deep, and subject to uplift varying from 30 percent of hydrostatic at the heel to zero at the toe. Uplift on the narrow base made it a GEM.

The sketch (Fig. 1) shows forces in kips for a unit section of the dam ABCD. Both men and boys found without difficulty the weight W, the horizontal water pressure H, and the innocent looking uplift U, but they diverged on the reaction R and its distribution.

Ike assumed a trapezoidal distribution (Fig. 2*a*) with rectangular and triangular parts. Dividing W into similar parts, he took moments about B:

$$40.5 \times 12 + 60 \times 5 + 18 \times 12 - 5.4 \times 5.33 = 16a \times 8 + 8b \times 10.67$$
$$3a + 2b = 973.2 \times 3/128 = 22.81$$
$$2a + b = 72.6/8 = 9.075$$
$$a = -4.659,\ b = 18.394$$

We don't know what went thru Ike's mind when he saw the negative value. Maybe he knew it couldn't be negative and guessed he made a mistake. He did a fair job of erasing the minus sign and gave as his answer, minimum 4.66 ksf, maximum $= a + b = 23.05$ ksf.

Mike thot like Ike except that he was more confident in his answer. He drew a pressure diagram (Fig. 2*b*) with suction at the heel and called his maximum 13.73 ksf at the toe. Then he noted that one atmosphere was 2.12 ksf, which limited suction to −2.12, the minimum pressure.

Jake was more direct. He located the reaction R 2.595 ft from A, noted that it was outside the middle third, said positively the dam would overturn, and concluded, "You must mean the pressure on the base becomes zero after overturn, or do you mean that AD is the new base?"

Luke was less cynical. He visualized the reaction with a triangular distribution over a length $3 \times 2.595 = 7.78$ ft and computed the maximum pressure at 18.65 ksf (Fig. 2*c*). The minimum couldn't be zero, he said, because the uplift is a pressure on the base. If the dam tipped by compressing the foundation under the toe, contact might be broken at the heel, admitting full hydrostatic pressure for uplift. He dodged this contingency nicely by pointing to the positive definition of uplift in the given conditions, then added R to U (Fig. 2*d*) to find the minimum pressure, 0.328 ksf.

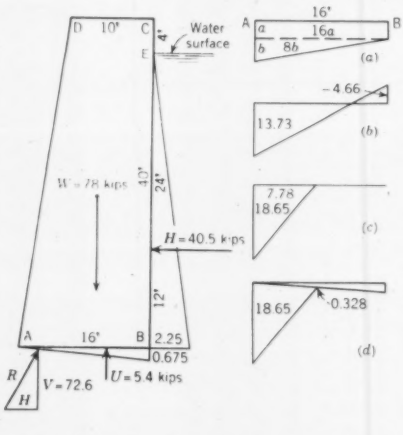


Fig. 1 (left). Loads on the dam.

Fig. 2 (right). Ike, Mike, Jake, and Luke disagree on reactions.

Luke, of course, is our hero. You may remember the lad who said, "It is too so cuz my mom says so, and when my mom says it's so, it *is* so, even if it isn't so". Luke was like that lad. If the Board said uplift was only 30 percent of hydrostatic at the heel, that was irrefutably that.

The moral is that examinees should know and do exactly what is specified. Here they were not asked if the design was sound, nor whether the dam would overturn, nor how to figure uplift under an unloaded heel, but just to work a hypothetical mechanics problem that wasn't in the book.

EXAMGEM No. 9

So many culvert problems have appeared on CE exams that it is hard to pick the best, so this one California used in April 1958 will be called just one of the best. You have to know where to start, what happens at each end, and more than a little about head losses. It read:

A box culvert 300 ft long placed on a 2 percent grade extends thru a highway embankment which has side slopes of 3:1.

(*a*) If both ends of the culvert are submerged and the upstream water surface is 4 ft higher than the downstream water surface, what size culvert is necessary to carry 250 cfs.

(*b*) As downstream conditions change, the outlet becomes free of backwater, what is the depth of flow in the culvert and the headwater elevation for the 250-cfs flow?

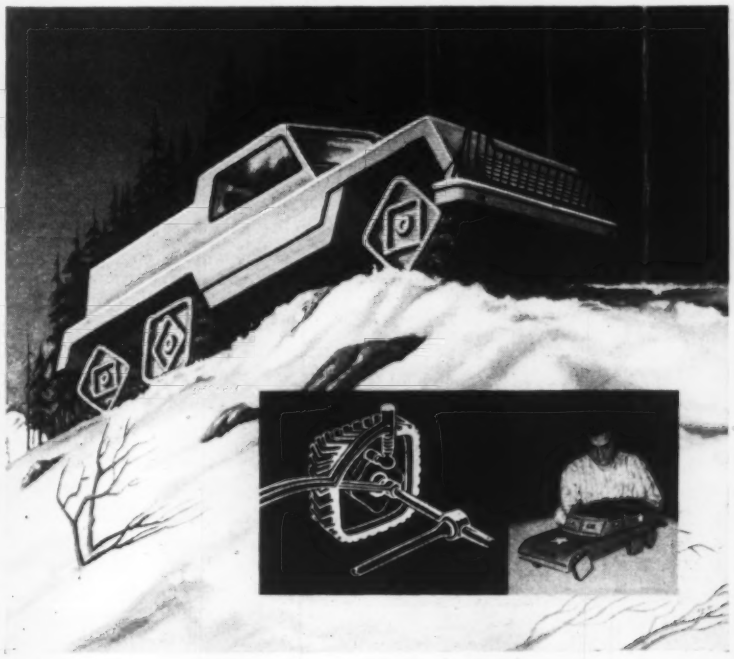
New Ways to Use Structural Steels

New ways to use the higher strength-to-weight ratios of modern structural steels in bridge design are suggested in a 38-page booklet. The publication covers the fifteen winning designs in the recent $44,000 Steel Highway Bridge Design Competition sponsored by the American Bridge Division of the U.S. Steel Corporation. It illustrates structural details of the prize-winning entries, discusses their noteworthy features, and gives background information on the designers.

The competition was held to "stimulate more imaginative and effective use of steel in highway overpasses." Conducted and judged under the auspices of the American Institute of Steel Construction, the competition drew more than 300 entries from the U.S. and 29 foreign countries.

A free copy of the booklet is available upon request to the American Bridge Division, U.S. Steel Corp., Room 1831, 525 William Penn Place, Pittsburgh 30, Pa.

No. 14 • Mars Outstanding Design Series



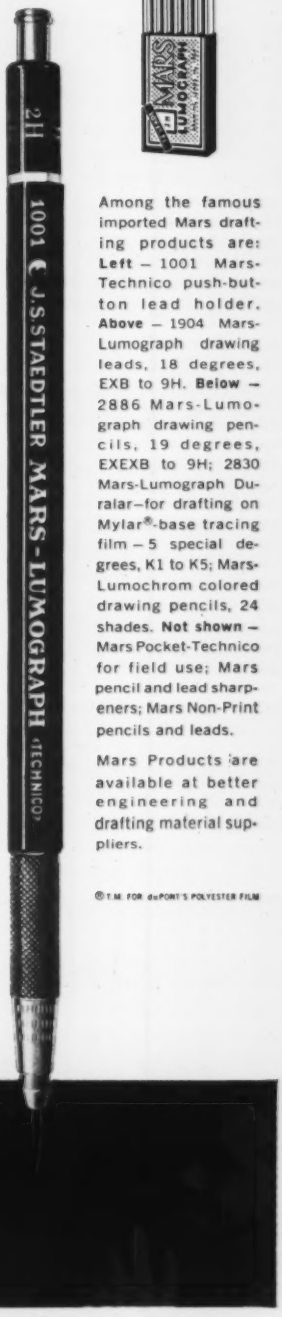
SQUARE WHEELS? Yes ... square wheels. Operating by means of a floating axle and cam gear, they take the bumps out of rough terrain and provide more traction. U.S. Patent No. 2786540 has been granted to designer Albert Sfredda of Bethlehem, Pa., for his invention.

The square shape gives superior traction in mud, sand, snow or uneven terrain. The flat surfaces of the wheels bridge the ruts instead of sinking into them as do round wheels. The wheels can be in any relative position, do not need to be synchronized—yet they run smoothly. Designed for use on heavy trucks, jeeps, farm or construction machinery, speeds up to 35 miles per hour can be attained.

This ingenious departure from age-old precedent is just one example of the contributions that today's designers are making. To help them translate their pace-setting ideas from concept to reality they require the best of drafting tools.

In pencils that means MARS, long the standard of professionals.

for the man who's going places...



Among the famous imported Mars drafting products are: **Left** – 1001 Mars-Technico push-button lead holder. **Above** – 1904 Mars-Lumograph drawing leads, 18 degrees, EXB to 9H. **Below** – 2886 Mars-Lumograph drawing pencils, 19 degrees, EXEXB to 9H; 2830 Mars-Lumograph Duralar–for drafting on Mylar®-base tracing film – 5 special degrees, K1 to K5; Mars-Lumochrom colored drawing pencils, 24 shades. **Not shown** – Mars Pocket-Technico for field use; Mars pencil and lead sharpeners; Mars Non-Print pencils and leads.

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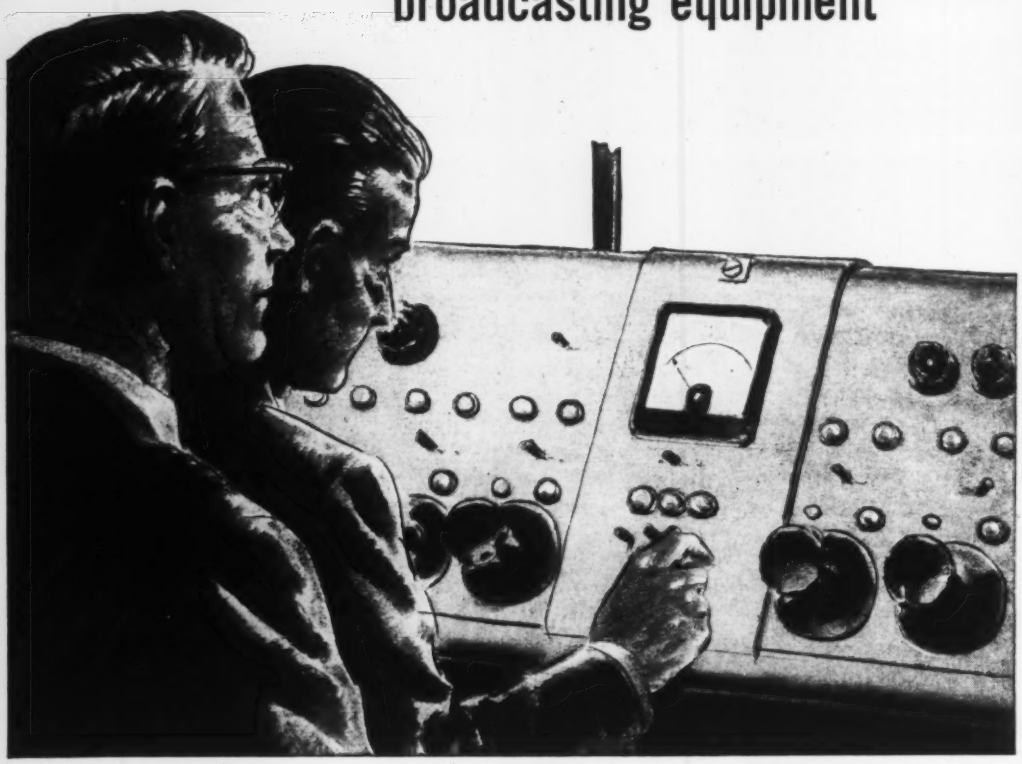

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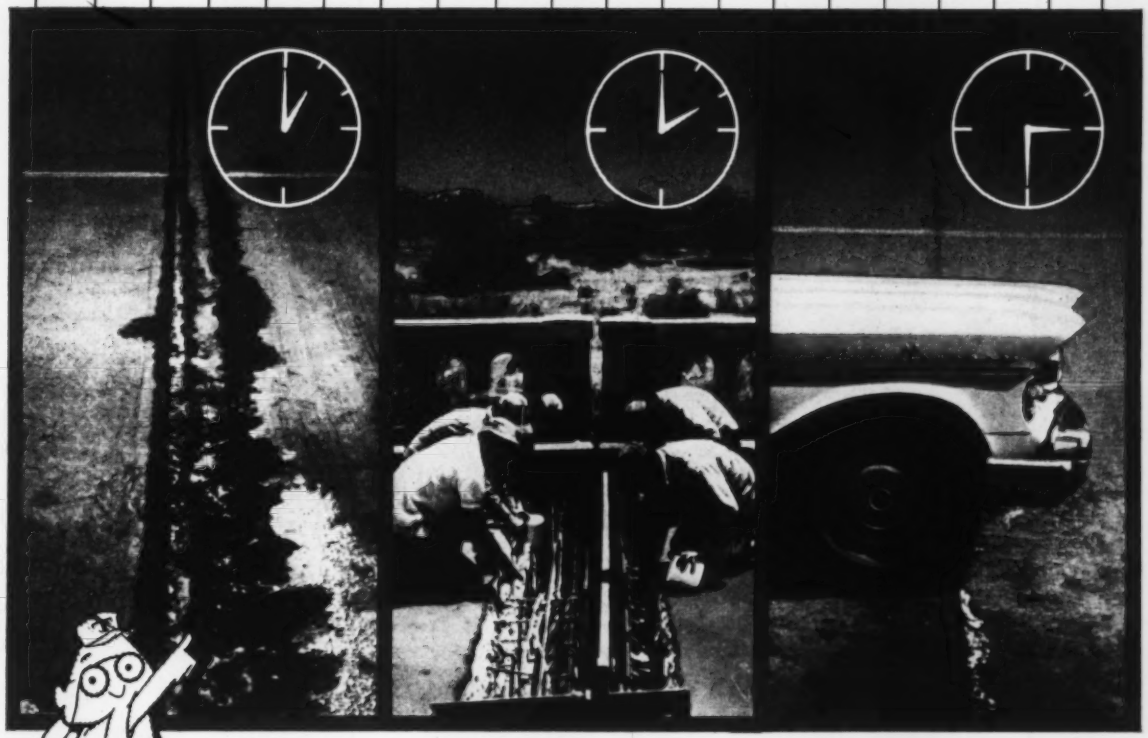
M3

REPORTS *on concrete bonding with adhesives based on THIOKOL Liquid Polymer*



#2 REPAIRING ROAD BREAKS *without causing* BOTTLENECKS

Truly the Achille's Heel of the Highway, spalled expansion joints are a frequent source of road failure throughout the country. Their complete repair by conventional methods generally requires several days, causes hazardous traffic squeezes or inconvenient re-routing.

Many states have found a happy solution to the problem by substituting a THIOKOL liquid polymer/epoxy resin compound for portland cement in remedial work. As pictured above, a spalled expansion joint has been laid bare, the THIOKOL LP/epoxy concrete installed, and the roadway is back in operation in 2½ hours! A job ordinarily taking 3 days! This particular repair was done several years ago and has served perfectly ever since.

Again and again, over a six year period, THIOKOL LP/epoxy compounds have proven their enormous adhesive strength in bonding old-to-old and new-to-old concrete. Repairs made with this material . . . such as patching pot holes, overlaying scaled areas, filling cracks, replacing broken slabs . . . have stood the test of time and wear on well-travelled roads in several states and climates.

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DECEASED

Benjamin C. Allin (M. '45; F. '59), age 73, designer of the Port of Stockton, Calif., and its administrator for eleven years, died in Berkeley, Calif., on January 10. Colonel Allin received national attention for his work on the Port of Houston, Tex., which he operated from 1919 to 1931 and as director of the Greater Miami (Fla.) Port Authority, 1944-1945. At the time of his death he was serving Redwood City as port facilities consultant.

Frank C. Amsbary, Jr. (M. '41; F. '59), age 59, vice-president, general manager and a member of the board of directors of the Long Island Water Corporation, Lynbrook, Long Island, N.Y., died in Rockville Centre on January 31. Beginning in 1923 with the Champaign-Urbana Water Company (now the Northern Illinois Water Company) as supervising engineer, Mr. Amsbary subsequently became vice-president. He left in 1955 to become affiliated with the Long Island Water Corporation.

C. R. Andrew (A.M. '11; M. '59), age 77, retired city engineer of Decatur, Ill., died in St. Petersburg, Fla., on January 22. During World War II, Mr. Andrew was cited by the War Department for "exceptional civilian service" for his efforts in directing work necessary to the passage of war vessels through the Illinois Waterway. Mr. Andrew had a consulting practice in Decatur prior to becoming city engineer.

Theodore Burton Appel, Jr. (M. '47; F. '59), age 55, chief engineer of the C. S. Johnson Company, of Champaign, Ill., died there on December 29. Mr. Appel had been an employee of the firm for fifteen years and previously was in the Construction Plant Division of the Tennessee Valley Authority. He was a graduate of Franklin and Marshall College (1926) and Massachusetts Institute of Technology (1929).

Brother J. Aubert (A.M. '36; M. '59), age 57, for thirteen years assistant dean of engineering at Manhattan College, New York City, died there on January 22. He had taught theology and civil engineering at the college since 1930, and was the author of a treatise, "Review Problems in Statics and Dynamics."

Raymond D. Bergman (A.M. '48; M. '59), age 45, for the past ten years resident engineer for the American Can Company at Hammond, Ind., died on January 2 in Decatur, Ga. At the time of his death, Mr. Bergman had just completed constructing a new plant at Forest Park, Ga. He was a 1947 graduate of the University of Colorado.

Ralph Peters Black (M. '14; F. '59), age 79, who retired in 1951 after twenty-eight years as associate professor of civil engineering at the Georgia Institute of Technology, died in Atlanta, Ga., on January 18. Early in his career, Mr. Black was engineer for the University of the South at Sewannee, Tenn., and built some structures there that are still regarded as landmarks. Mr. Black was a past president of the Georgia Section.

Wilbur Lee Shelton Blankenship (M. '46; F. '59), age 54, whose professional life has been spent in the employ of the City of Richmond, Va., died there recently. At the time of his death Mr. Blankenship was chief of the Bureau of Sewers and Structures in Richmond's Department of Public Works, in which capacity he had responsibility for the sewage disposal plant, railroad facilities, the airport, and maintenance of Lee Bridge.

Frank R. Burnette (M. '26; F. '59), age 71, retired U. S. Steel Corporation official at Pittsburgh, Pa., died in Bethel Park, Pa., on January 11. Mr. Burnette retired in 1956 as assistant executive vice-president for engineering and raw materials at U. S. Steel after six years in the post. Previously he was a superintendent and assistant chief engineer for the Carnegie Illinois Steel Company.

William E. Corfitzen (M. '48; F. '59), age 58, chief of the U. S. Economic Mission in the United Nations trust territory of Somalia, East Africa in 1957 and 1958, died on February 4 in Bethesda, Md. In 1934 he joined the U. S. Bureau of Reclamation in Denver, and in 1941 was made chief of its Foreign Activities Section in Washington. Since then he had been in Athens as a reclamation specialist as part of the original U. S. mission for aid to Greece and was a reclamation specialist with the U. S. Operations Mission to Italy.

Homer W. Deakman (A.M. '20; M. '59), age 65, since 1924 executive vice-president of the Deakman-Wells Company, a general building construction firm, of Jersey City, N. J., died there on December 9. Several years prior to joining Deakman-Wells, Mr. Deakman was superintendent of construction with the Hegeman-Harris Company, of New York City, employed in building banks, office buildings and industrial plants.

Leo J. Ehrhart (A.M. '22; M. '59), age 70, former president of the Bronx Board of Trade and a civil engineer prominent in the development of New York City real estate, died on January 13 in Miami Beach, Fla. He headed the former engineering firm of Leo J. Ehrhart & Company, Inc., and in the 1920's was associated with Joseph P. Day in the development of the Clason Point Military Academy on City Island and the Hunts Point section of the Bronx. He also developed the Astor and Belmont estates on Long Island, N. Y.

K. D. Farwell (M. '51; F. '59), age 59, partner in the Chicago, Ill., firm of Pace Associates, died in Chicago on January

(*Continued on page 110*)

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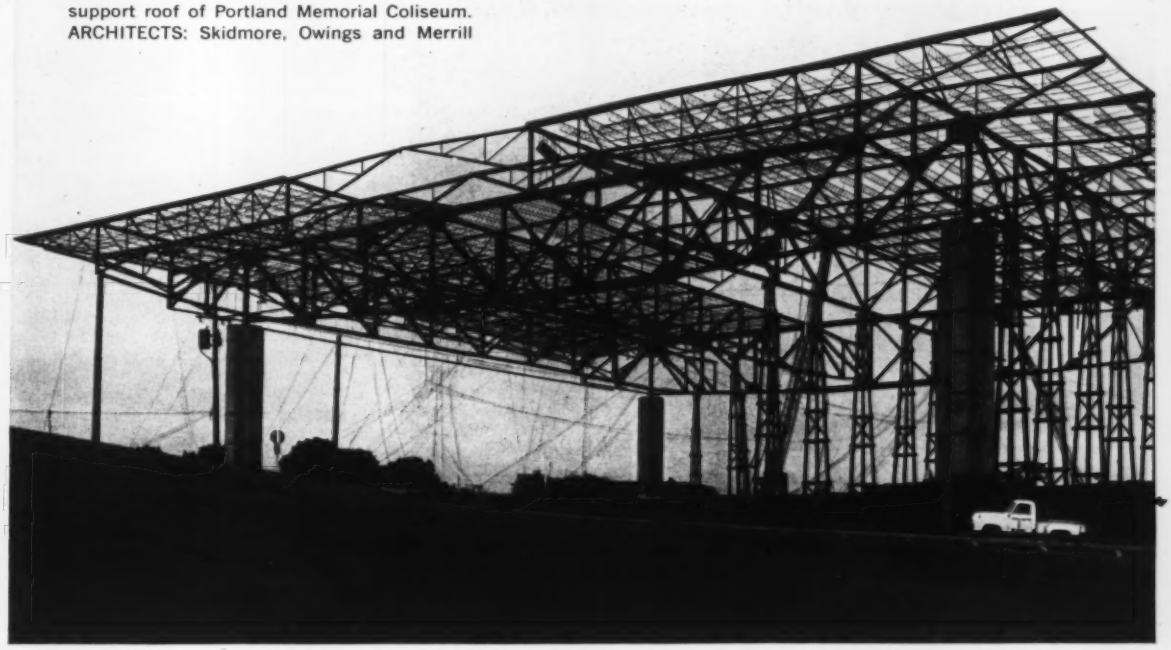

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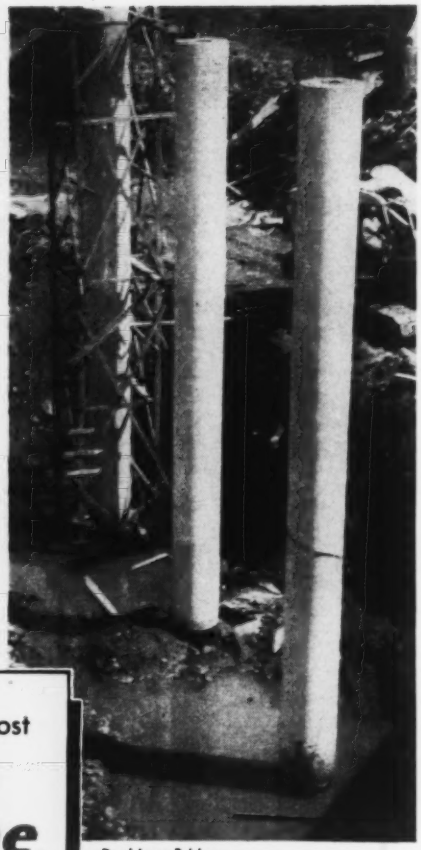

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8. During part of his thirty years engineering experience, Mr. Farwell was superintendent of construction for the reconstruction of Camp Grant at Rockford, Ill., and the $22-million Scioto Ordnance Plant at Marion, Ohio, for the Army Corps of Engineers.

Frank L. Gorman (M. '19; F. '59), age 72, Colonel, U. S. Army (retired), died in Fairview Park, Ohio, on January 5. A few days earlier he had retired as Cleveland's chief engineer of port control. Mr. Gorman had been identified with many enterprises in the Cleveland metropolitan area including the design of parts of the Union Terminal and Terminal Tower and several bridges across the Cuyahoga River. He was also a designer for the New York Central System.

Forrest Shepherd Harvey (M. '22; F. '59), age 74, former U. S. Aide, of Pasadena, Calif., died there recently. As a major in the Quartermaster Corps, 1917-1920, Mr. Harvey worked on the construction of Camp Taylor, Port Newark Terminal, Charleston Port Terminal, and army installations at the Panama Canal. In 1940 he served in the War Department as chairman of the War Contracts Board, receiving the Medal of Exceptional Service for this work. He continued to serve the War Department until his retirement in 1948.

Daniel Boone Jett (M. '38; F. '59), age 73, long-time member of the civil engineering staff at the New Mexico State University, died on January 10 in University Park, N. Mex. Since joining the staff in 1926, he had served as instructor, assistant professor, associate professor, professor and most recently as dean of engineering.

Richard W. Jones (M. '49; F. '59), age 53, since 1933 a member of the General Construction Company, of Seattle, Wash., died recently in the crash of a light aircraft while en route from Seattle to Portland. At the time of his death he was executive vice-president at General Construction. Previously he worked for the company on such projects as Bonneville Dam, numerous important marine projects in the Puget Sound area, and as chief engineer of Hungry Horse Dam.

Walter E. Joyce (M. '32; F. '59), age 72, an expert on the design and construction of suspension bridge cables, died in San Francisco, Calif., on December 28. Mr. Joyce, who retired a year ago as senior associate with D. B. Steinman, New York City, for the past year had acted as a consultant to the firm. While with D. B. Steinman Mr. Joyce designed and erected the cables for the Mackinac Bridge in Michigan. Earlier as resident engineer for the John A. Roebling's Sons Company he constructed the cables for both the George Washington Bridge in New York and the Golden Gate Bridge in California.

Joseph F. Kern (A.M. '11; M. '59), age 80, a retired civil engineer, died recently

(Continued on page 112)

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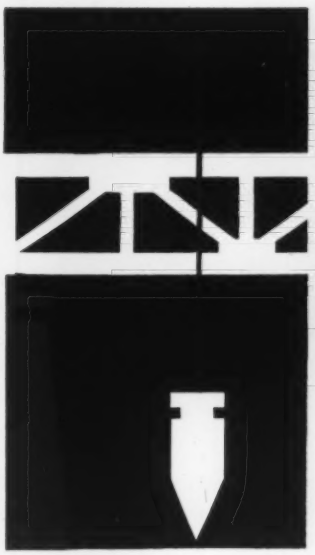

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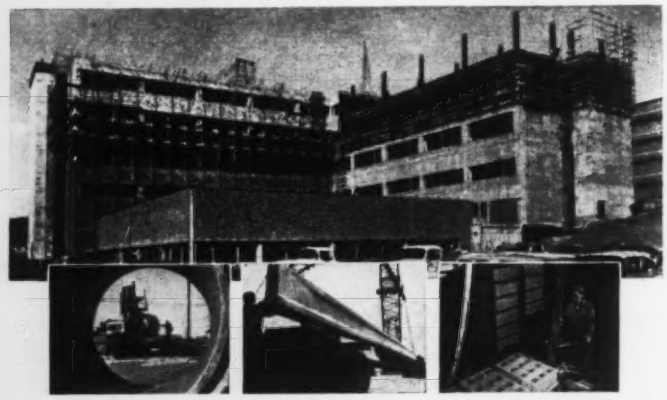

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in Elmhurst, N. Y. During his career, Mr. Kern built a railroad from the Pacific Ocean to the headwaters of the Amazon River for the Ecuadorian government, and the Key West (Fla.) railroad, since replaced by a highway over the Keys. He also served for several years as superintendent of construction in the New York State Department of Public Works.

Robert E. McDonnell (M. '09; F. '59), age 87, co-founder of the Kansas City, Mo., firm of Burns and McDonnell, died on January 2 in Kansas City. The firm, which was founded in 1898 and specializes in utilities for municipalities, numbers among its clients the cities of Cincinnati, Kansas City (Kans.), Knoxville, Milwaukee, Tampa, Kansas City (Mo.), Omaha, Little Rock, Cleveland and Springfield. Mr. McDonnell retired in 1948 as senior partner in the firm.

Harry H. Meyer (M. '30; F. '59), age 64, who retired in 1953 as chief structural engineer for the engineering firm of Sanderson & Porter, New York City, died at White Plains, N. Y., on January 14. During his thirty years with the firm, Mr. Meyer supervised the structural development of many power utility installations.

Charles T. Middlebrook, Jr. (M. '09; F. '59), age 92, a pioneer in the development of reinforced concrete construction on the east coast, died recently in Albany, N. Y. Six years ago Mr. Middlebrook retired from private practice after forty-six years as a designing and consulting engineer in structural steel and reinforced concrete, and in hydroelectric power development. For part of this period he was a consulting engineer for the Delaware and Hudson Railroad and assistant engineer on the New York State Barge Canal.

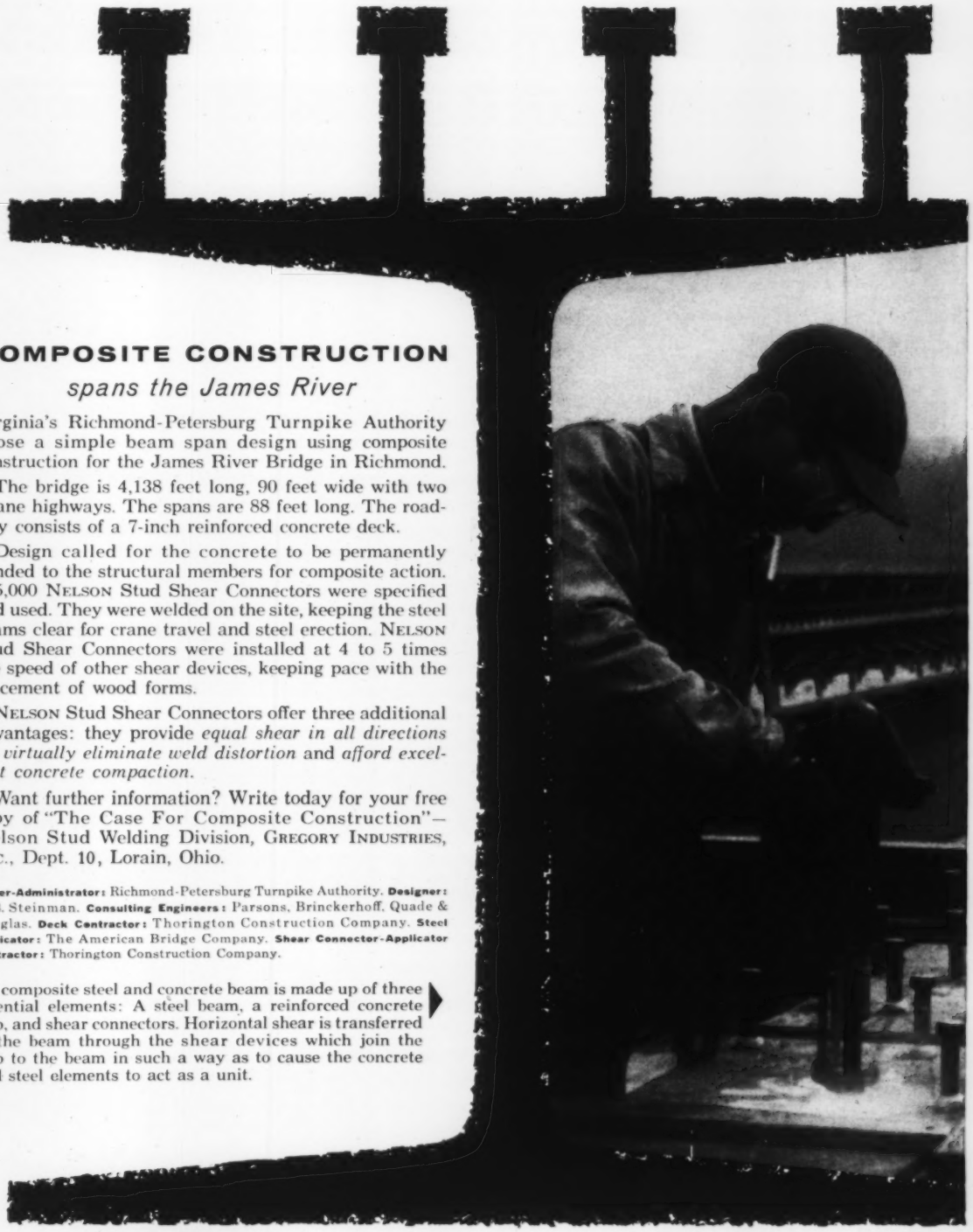
R. B. Moore (M. '39; F. '59), age 64, retired civil engineer, of Indianapolis, Ind., died there on January 12. Mr. Moore was one of the founders of the Indianapolis firm of Moore and Heger Engineering.

Humphrey A. W. Morrice (M. '51; F. '59), age 53, former irrigation adviser and director of irrigation for the Sudan Government at Wad Medani, Sudan, died in North Colchester, England, on December 31. For over twenty-five years Mr. Morrice had been with the Sudan Irrigation Department, as division engineer on the million-acre Gezira Irrigation scheme and as assistant to the chief engineer on the Gash Delta Irrigation scheme.

Charles W. Morrison (A.M. '23; M. '59), age 75, vice-president of the New York firm, Cross and Brown Company, and a valuation specialist, died recently in New York. A member of the organization since 1937, Mr. Morrison had previously served the Interstate Commerce Commission as senior land appraiser and the Joseph P. Day Company, of New York, as real estate appraiser.

H. Lane Ogle (M. '30; F. '59), age

(*Continued on page 114*)



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Owner-Administrator: Richmond-Petersburg Turnpike Authority. **Designer:** D. B. Steinman. **Consulting Engineers:** Parsons, Brinckerhoff, Quade & Douglas. **Deck Contractor:** Thorington Construction Company. **Steel Fabricator:** The American Bridge Company. **Shear Connector-Applicator Contractor:** Thorington Construction Company.

*A composite steel and concrete beam is made up of three essential elements: A steel beam, a reinforced concrete slab, and shear connectors. Horizontal shear is transferred to the beam through the shear devices which join the slab to the beam in such a way as to cause the concrete and steel elements to act as a unit.

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65, retired civil engineer, of Stamford, Conn., died on January 20 in Stamford. Mr. Ogle was the builder of 2 Beekman Place in New York City, and at the time of his retirement a few years ago was president of Lane Ogle, Inc., of New York. A Navy veteran of both wars, he served with the rank of commander in World War II.

Ralph Parshall (A.M. '26; M. '59), age 78, internationally-known water authority and director of irrigation investigations at Colorado State University's famed hydraulics laboratory, from 1918 until 1947, died at Fort Collins, Colo., on December 29. Although in semi-retirement for more than a dozen years, Mr. Parshall last December 7 completed a history of hydraulics research at CSU. His most notable contribution to the science of irrigation, the flow-measuring device known as the Parshall Flume, is still being used after thirty years.

Benjamin H. Petty (M. '38; F. '59), age 71, professor emeritus of highway engineering at Purdue University, Lafayette, Ind., died recently in Dothan, Ala., while en route to his new home in Sarasota, Fla. At the time of his retirement last July, Professor Petty had been a member of the Purdue staff since 1920 and director of Purdue's annual road school since 1924. He was one of the nation's foremost authorities on highway planning and building.

James H. Philips (M. '07; F. '59), age 86, retired civil engineer, of Fort Lauderdale, Fla., died there recently. Retired since 1940, Mr. Philips' accomplishments included construction of numerous parks for the Essex County Park Commission as chief engineer; construction of a double track tunnel through Jersey City, N. J., for the Delaware, Lackawanna and Western Railroad; and construction of the New York State Barge Canal for the Atlantic, Gulf & Pacific Company as engineer and assistant superintendent.

Silas Bent Phillips (A.M. '09; M. '59), age 82, retired structural engineer of the Stone and Webster Engineering Corporation, Boston, Mass., died in Newton, Mass., on January 18. Mr. Phillips, after serving with several railroads in various capacities, joined the construction department of Stone and Webster in 1917, becoming structural engineer three years later.

Carl D. Pollock (M. '25; F. '59), age 74, retired consulting engineer and specialist in public utility valuation, died in Seattle, Wash., on December 14. Beginning in 1916 he worked for eight years with the Alaska Engineering Commission on the construction of the Alaska Railroad, and from 1938 to 1941 he was chief engineer for the Kentucky Public Service Commission. More recently he worked for the Army Corps of Engineers on Shemya Island, Alaska, and Prince Rupert, British Columbia.

Wardner G. Scott (M. '48; F. '59), age 63, from 1941 to 1948 Nebraska state engineer, died in Lincoln, Nebr., on December 28. In 1920 he joined his father, the late Winfield Scott, in the engineering firm, Scott & Scott, dissolving it in 1941 to become state engineer. More recently he was senior partner of Hoskins & Associates and president of the W. A. Lynn Construction Company and the Central States Bridge Company.

Elwyn E. Seelye (M. '15; F. '59), age 75, a partner in the New York engineering firms of Seelye, Stevenson, Value & Knecht and Grad, Urbahn & Seelye, died in White Plains, N. Y., on December 28. Projects with which Mr. Seelye's firms were identified included the world's largest telescope, currently under construction at Sugar Grove, W. Va.; the Thomas Jefferson Memorial in Washington, D. C.; office and factory buildings in the New York area; military structures and installations in the U. S. and abroad; the Queensbridge Housing Development in New York; sections of the New York State Thruway, the Northway, and the Connecticut Turnpike; and additions to the British Museum in London and the Library of Congress in Washington. Mr. Seelye also wrote the three-volume *Data Book for Civil Engineers*, which recently had its third printing.

George Austin Sherron (M. '16; F. '59), age 78, who retired twelve years ago as vice-president and manager of the Rhinelander Real Estate Company, of New York City, died in Sarasota, Fla., recently. Prior to joining the Rhinelander Company, he served as village manager of Port Chester, N. Y.; as field engineer in the Street Department and superintendent of the Construction Department for the Consolidated Gas Company of New York; and as city engineer and street commissioner of Norwalk, Conn.

Frederick B. T. Siems (M. '55; F. '59), age 71, who retired in 1949 after forty-one years of active service with the U. S. Coast and Geodetic Service, died on December 21, in Baltimore, Md. Captain Siems' last duty was as commanding officer of a survey ship, *The Explorer*, based at Seattle, Wash.

Abraham Streiff (M. '27; F. '59), age 79, well-known as a consultant on hydraulic and hydroelectric power projects in this country and abroad, died in Jackson, Mich., on January 4. For twenty-five years he was associated with the Fargo Engineering Company of Jackson and for the past eight years was a special consultant to the American Smelting and Refining Company of New York City.

George R. B. Symonds (M. '26; F. '59), age 73, retired town engineer and Director of Streets and Public Improvements of Nutley, N. J., died there recently. In his early career he was civil engineer with the Bureau of Public Works for the Government of the Philippine Islands, where for one year he had complete charge of all irrigation work. More recently, he was executive officer to the Chief of the Requirements and Resources Section of the Supply Division in Washington, D. C.

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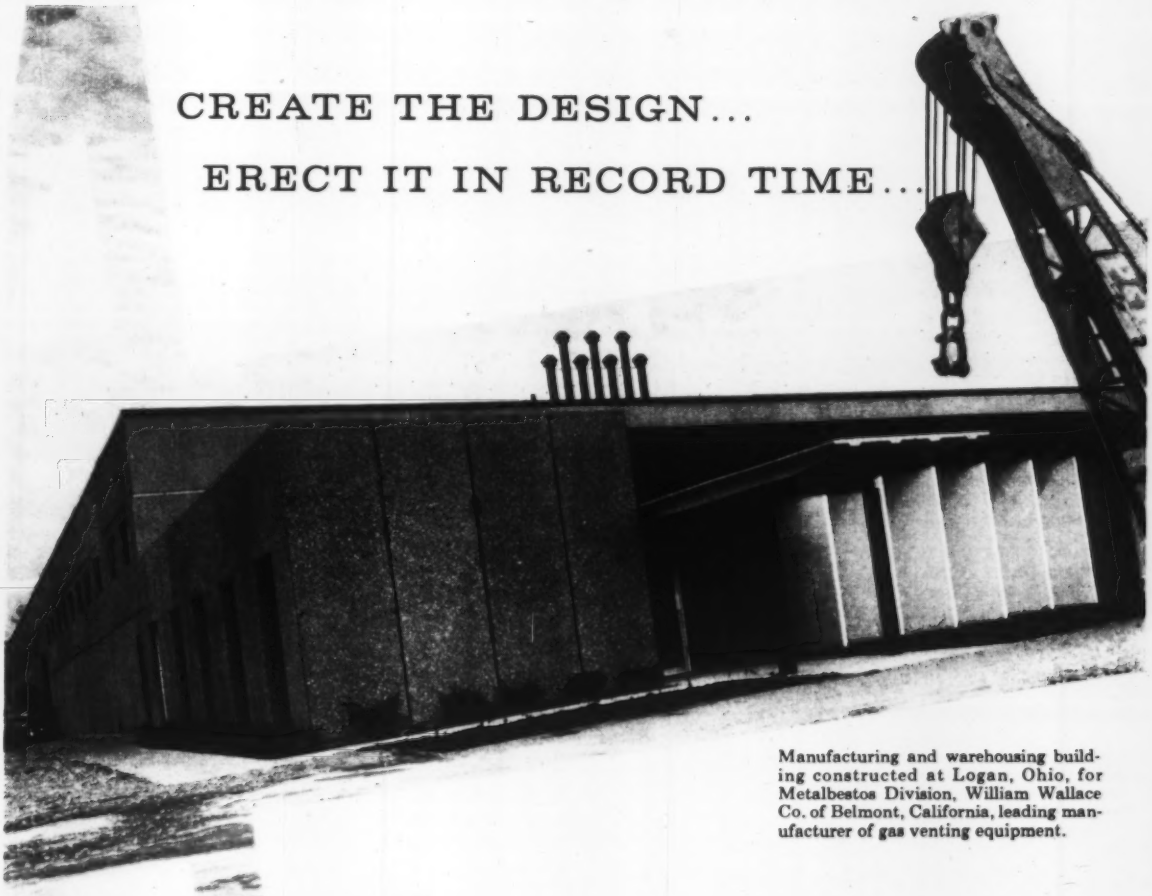

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Consulting services for highway work . . . . A study dealing with scope and fees for engineering services performed by consultants on highway projects in the United States has been prepared by the Committee on Professional Engineering Services of the American Road Builders' Association. Copies of the timely bulletin, identified as Publication No. 245, may be obtained from the American Road Builders' Association (World Center Building, Washington 6, D. C.), at 50 cents apiece.

Structural engineering . . . . Application of the algebraic carry-over moment method to the analysis of multi-span continuous beams of constant or variable cross section is presented in Publication No. 106 of the Oklahoma State University Engineering Experiment Station. The title is "Influence Lines for Continuous Beams," and the authors are Kerry S. Havner and Jan J. Tuma, F.. ASCE. Copies, priced at $1.50 each, may be obtained from the Engineering Experiment Station, Oklahoma State University, Stillwater, Okla.

Questions for surveyors . . . . In "3030 Review Questions for Surveyors," Russell C. Brinker, F. ASCE, provides up-to-date aid for men taking Civil Service, Engineer-in-Training, and Professional Registration examinations in surveying and civil engineering. This 295-page sixth edition contains all types of questions—multiple-choice, completion, discussion, true and false, and problems—plus typical registration examinations. It also includes 30 pages of theory, practical suggestions, and 54 problem solutions worked-out. Copies may be obtained from Mr. Brinker (4217 Norfolk Lane, El Paso, Tex.), at $4.50 each, plus 14 cents postage. On orders of five or more copies, the price is $4.00 per copy, and postage is free.

Highway research . . . . A wide range of research in road problems and allied fields of interest is reported in recent publications of the Highway Research Board (2101 Constitution Avenue, Washington 25, D. C.), from whom they may be ordered. The list includes Bulletin 225, "Highway Pavement Design in Frost Areas," $2.60; Bulletin 227, "Highways and Economic Development," $1.60; Bulletin 228; "Photogrammetry: Developments and Applications, 1959," $1.20; Bulletin 229, "Concrete Pavement: Subbase and Joint Construction," $1.00; Bulletin 230, "Trip Generation and Urban Freeway Planning," $2.40; Bulletin 232, "Land Acquisition—1959," $2.40; Bulletin 233, "Flexible Pavement Design Research—1959," $1.00; and Bulletin 234, "Performance and Tests of Asphaltic Concrete," 50 cents.

Scientific manpower . . . . Various aspects of the scientific manpower situation are explored in two recent publications of the National Science Foundation. "Scientific Manpower 1958," the third in a series of annual summaries of developments in the field, contains the proceedings of the annual Scientific Manpower Conference held during the meeting of the American Association for the Advancement of Science. "American Scientific Manpower—Employment and Other Characteristics" is based on the National Register of Scientific and Technical Personnel, compiled in 1954 and 1955. Inquiries about both publications should be addressed to the National Science Foundation, Washington 25, D. C.

Vocational guidance . . . . Edward H. Robie, secretary emeritus of the AIME, is author of a helpful guidance pamphlet on engineering, one of a series of vocational and professional monographs issued by the Bellman Publishing Company. Identified as Monograph No. 14, the brochure may be obtained from the Bellman Publishing Company, Post Office Box 172, Cambridge 38, Mass. Copies are $1.00 each.

Engineering education . . . . The complete report on a "Study of the Purdue University Engineering Graduate" is now available as a 300-page bulletin in the Engineering Extension Series. This report—by W. K. LeBold, J. W. Gillis, G. A. Hawkins, and E. C. Thoma, M.ASCE—is based upon a 1957 questionnaire addressed to Purdue engineering alumni, faculty, and students. The bulletin, priced at $2.50, should be ordered from the Engineering Experiment Station, Purdue University, Lafayette, Ind. Checks should be made payable to Purdue University.

Arctic construction . . . . "Arctic Engineering" is the title of a Navy manual on construction and maintenance of installations in Arctic regions, which has been made available for sale to industry by the Office of Technical Services. The 473-page illustrated manual costs $6.00. Orders should be sent to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Water meters . . . Publication of a new Manual Water Works Association, 2 Park Avenue, New York 16, N. Y. The 88-page booklet covers the essentials of cold-water meter selection, installation, testing, and maintenance. The manual was prepared by the AWWA Committee on Meters to fill a long-felt need for a practical guide in the field. Known as AWWA M6, the manual sells for $1.25 a copy.

Professional Engineer examinations . . . . Complete structural design examinations given by the State of New Jersey in December 1958 have been made available with answers by Prof. Odd Albert, M. ASCE, of Monmouth County Community College. The answers are fully worked out, providing every step needed to a complete understanding of how solutions are reached. Where several solutions are possible, Professor Albert has supplied them. The sets may be ordered from the Opla Company, Box 266, Belmar, N. J. The price is $1.00.

Air pollution laws . . . . As the initial release in a projected government series of publications on air pollution control, the Public Health Service of the U. S. Department of Health, Education, and Welfare has issued "A Digest of State Air Pollution Laws." The Digest will be revised and supplemented from time to time to keep it abreast of new legislation. Identified as Public Health Service Publication No. 711, the 117-page compilation is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. It is 75 cents.

Basic Research in the Navy . . . . The recently publicized report to the Navy, which calls basic research "the life-blood of the entire system of technological innovation" and advises the Navy to do more of it, has now been made available to the public through the Office of Technical Services. The report, entitled "Basic Research in the Navy," is based on findings of a two-year investigation of basic research in industry, the government, and the universities. It was prepared for the Navy Research Advisory Committee by Arthur D. Little, Inc., under the sponsorship of the Office of Naval Research. The two-volume report, priced at $7.00, may be ordered from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Concrete . . . . Users of concrete will be interested in two helpful Manuals of Recommended Practice recently made available by the Concrete Industry Board. One deals with "Concreting Operations During Hot or Cold Weather"; the other with "The Production, Delivery, and Use of Ready Mixed Concrete." Inquiries should be made to the Concrete Industry Board, Inc., 220 East 42nd Street, New York 17, N. Y.

Standards for fasteners . . . . As a guide for manufacturers and users of industrial fasteners, the Industrial Fasteners Institute has issued a revised and enlarged edition (the third) of "Bolt, Nut, and Rivet Standards." The 288-page publication assembles all the nationally recognized dimensional standards in the field, including bolts, nuts, studs, screws, washers, and rivets. Most of the standards were developed through the procedures of the American Standards Association. Copies are available at $3.00 each from the Industrial Fasteners Institute, 1517 Terminal Tower, Cleveland 13, Ohio.

New ANCO High-Tensile Structural Bearing Bolts

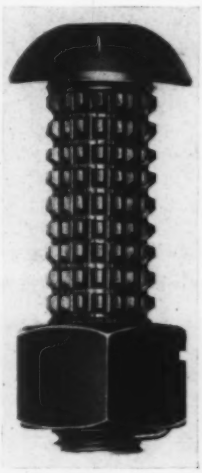
Meet Rigid Requirements For 398′ High-Tension Towers

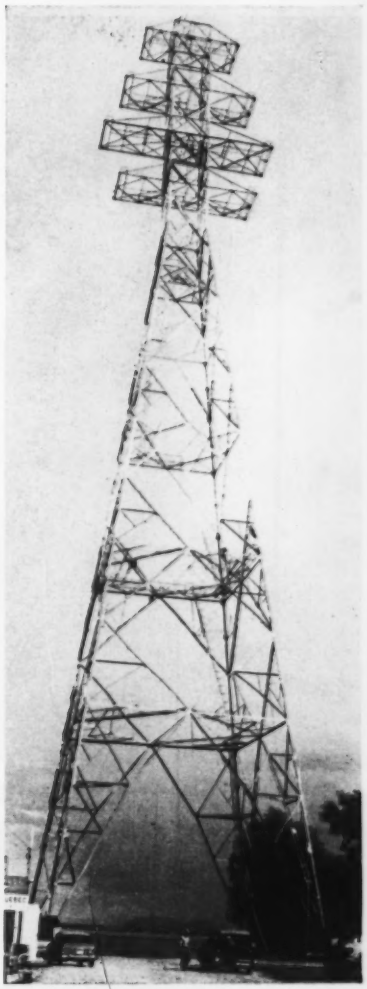
ANCO High-Tensile Structural Bearing Bolts of a new interrupted rib design have been successfully used in the erection of 398-foot river-crossing, high-tension power transmission line towers for the Quebec Hydro-Electric Commission. The towers are part of a 400-mile, 300-kw double circuit line and take one of the lines across the St. Lawrence River from Bout de L'Ile to Laprairie, P.Q. They were designed and fabricated by Cobra Industries, Inc. of Quebec, P.Q., and erected by the Canadian Hoosier Engineering Company, Ltd.

Because the towers were constructed of galvanized steel, and because of their great height, the designer required a high-strength structural bearing bolt-and-nut combination in which the bolt would connect the members in full bearing, but with no steel in bearing on the bolt threads. This would make it unnecessary to torque the nuts.

ANCO High-Tensile Structural Bearing Bolts and Lock Nuts proved to be the answer. They can be installed by one man, eliminating the problems and high costs of using pneumatic tools and equipment in erecting the higher sections of the towers. The relatively hard ribs burnish grooves in the holes of the structural members, but do not peel off while being driven, and do not pack material under the head. Bolts with the proper rib length for the thickness of the plates to be joined were used so that no metal was in bearing on the threads.

For more than 25 years, ANCO Structural Rib Bolts and Lock Nuts have been selected for all types of towers . . . for radio, television, high tension power transmission lines, micro-wave, radar antennas and reflectors, and many others. They are approved for all types of Federal, State and private projects. They can be furnished black or galvanized. Write today for samples, technical test data and prices without any obligation.





ABOVE—More than 56,000 ANCO High-Tensile Structural Bearing Bolts and a like number of ANCO Lock Nuts were used in seven river-crossing towers. Five were suspension towers like the one above—398 feet high, weighing 205 tons, and with a cross-arm spread of 77 feet. Two were anchor towers—145 feet and 165 feet high.

LEFT — ANCO High - Tensile Structural Bearing Bolts and Lock Nuts can be installed by one man using a drive hammer and hand wrench. Bolts have a flattened head for better driving and a short taper at rib end for easier insertion. ANCO Lock Nuts require no torquing and will not loosen under severe strain or vibration.

AUTOMATIC NUT COMPANY

INC.

LEBANON, PENNSYLVANIA

Compare the clean, simple lines of this structure with the heavier, haunched construction apparent in elastically designed buildings. Savings accrue through faster, easier, prefabricated construction as well as through lighter weight steels.

There's an Inland Structural Steel for every new construction idea

Plastic Design

is today more and more coming into widespread use in one and two-story rigid-frame structures. It presents welcome opportunities for reducing labor, time and material costs, for plastic design is based not upon the concept of maximum stress of a member—but upon the *load-carrying capacity of the entire structure.*

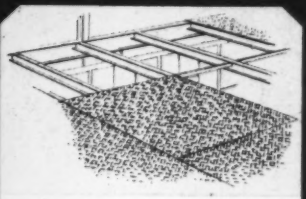
In elastic design, the entire member must be designed for the maximum moment. In plastic design, since the moment is distributed to the structure as a whole, no single member need be over-designed and substantial savings—from 5% to 35% in labor and materials—are possible. In addition, since the more indeterminate the structure the greater the saving, design time can actually be reduced by as much as 80%.

If you are contemplating the design or construction of a new building, remember that plastic design is applicable only to a ductile metal such as steel. The considerable savings possible, make it well worth your careful investigation.

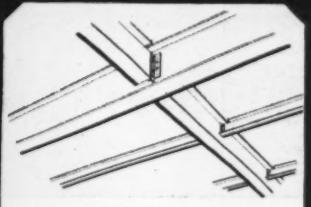
Plastic design is accepted by all four National Building Codes as well as many state and municipal codes. For complete information on this modern, cost-cutting construction method, see your local fabricator who now has structural steel available in all shapes and sizes—or call the American Institute of Steel Construction office in your area.

Use Steel *For Modern Construction*

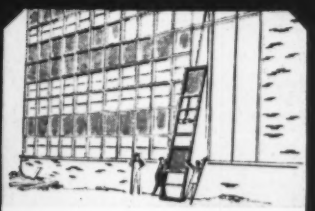
other Inland construction products



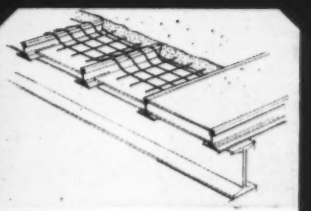
4-WAY SAFETY PLATE has come into general use as an integral, prefabricated part of the supporting structure, providing durable floors and added strength.



WIDE FLANGE BEAMS are the answer wherever more strength with less weight, longer spans with more open floor area, is the goal. Sizes from 8' to 24'.



INLAND ENAMELING IRON is ideally suited to curtain-wall and enameled panel systems, providing strength, beauty and unlimited design possibilities.



INLAND SUB-PURLINS are especially designed to provide a lighter, more efficient member for shorter-span roofs. They come cut-to-length and mill painted.

INLAND

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Chicago 3, Illinois

Non-ASCE Meetings

Air Pollution Control Association. Annual meeting at the Netherland Hilton Hotel, Cincinnati, Ohio, May 22-26. Arnold Arch, Executive Secretary, APCA, 4400 Fifth Avenue, Pittsburgh 13, Pa.

American Congress on Surveying and Mapping, and American Society of Photogrammetry. Convention and exhibit at the Shoreham Hotel, Washington, D.C., March 20-26.

American Institute of Architects. Annual convention at the new Masonic Temple, San Francisco, Calif., April 18-22. Convention headquarters will be at the Mark Hopkins Hotel. Donn Emmons, Chairman, Northern California Chapter, AIA, or AIA, 1735 New York Avenue, N.W., Washington, D.C.

American Institute of Electrical Engineers. Spring conference at the Baker Hotel, Dallas, Tex., April 11-13. AIEE, 29 West 39th Street, New York, N.Y.

American Institute of Industrial Engineers. Annual meeting at the Dallas-Sheraton Hotel, Dallas, Tex., May 12-14. AIIE, 145 North High Street, Columbus 15, Ohio.

American Power Conference. Twenty-second annual meeting sponsored by the Illinois Institute of Technology at the Hotel Sherman, Chicago, Ill., March 29-31. R. A. Budenholzer, Conference Director, Mechanical Engineering Department, Illinois Institute of Technology, 3300 Federal Street, Chicago 16, Ill.

American Rocket Society. Ground support equipment conference at the Statler-Hilton Hotel, Detroit, Mich., March 23-25. James J. Harford, Executive Secretary, ARS, 500 Fifth Avenue, New York 36, N.Y.

American Water Works Association. Eightieth annual conference at Bal Harbour, Fla., May 15-20. Conference headquarters will be the Hotel Americana. Raymond J. Faust, Secretary, AWWA, 2 Park Avenue, New York 16, N.Y.

American Welding Society. Forty-first annual convention and welding exposition at the Biltmore Hotel and the Great Western Exhibit Center, Los Angeles, Calif., April 25-29. AWS, 33 West 39th Street, New York 18, N.Y.

Building Officials Conference of America. Forty-fifth annual convention at the Eden Roc Hotel, Miami Beach, Fla., May 23-26. O. M. Pushkin, Chairman, BOCA, 1525 East 53rd Street, Chicago, Ill.

Building Research Institute. Spring conference at the Statler-Hilton Hotel, New York, N.Y., April 5-7. Jean H. Houtchens, Manager, Information Services, BRI, 2101 Constitution Avenue, Washington 25, D.C.

California Sewage and Industrial Wastes Association. Thirty-second annual conference at the Claremont Hotel, Berkeley, Calif., April 27-30. A. D. Leipzig, Secretary-Treasurer, c/o Hyperion Sewage Treatment Plant, 12000 Vista Del Mar, Venice, Calif.

Conference on Algae and Metropolitan Wastes. Conference at the R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio, April 27-29. A. F. Bartsch, Asst. Chief for Special Technical Services, Water Supply & Water Pollution Research, 4676 Columbia Parkway, Cincinnati, Ohio.

Engineering Institute of Canada. Seventy-fourth annual general and technical meeting at the Royal Alexandra Hotel, Winnipeg, Manitoba, May 25-27.

International Construction Exhibition. Second International Exhibition at the Palace of the National Industrial and Technical Center, Paris, France, March 17-27 Exhibition Secretariat, ICE, 1, Avenue Niel, Paris XVII, France.

International Symposium on Active Networks and Feedback Systems. Meeting at the Engineering Societies Building, New York, N.Y., April 19-21.

Manhattan College. Third Biological Waste Treatment Conference at the Riverdale campus, New York, N.Y., April 20-22. W. Wesley Eckenfelder, Associate Professor, Civil Engineering Department, Manhattan College, Riverdale, New York 71, N.Y.

New York State Association of Highway Engineers. Twenty-first annual convention, Syracuse, N.Y., April 6-8. New York State Association of Highway Engineers, District 7, 444 Van Duzee Street, Watertown, N.Y.

Society of American Military Engineers. National convention in Washington, D.C., May 19-20. Robert W. Crory, Manager, SAE, Meetings Operation Department, 485 Lexington Avenue, New York 17, N.Y.

Applications for Admission To ASCE, January 2-30, 1960

Applying for Member

CARLOS GAVINO ABRILLE, San Francisco, Calif.
LAWRENCE LEO AMES, Tacoma, Wash.
CHRISTOFOROS ANDRITSOS, Athens, Greece
RENATO GAMA BARRETO, Chicago, Ill.
GEORGE BENEDICT BEGG, JR., Bethesda, Md.
MARJAN ANTON BRILLY, Beograd, Yugoslavia
ROBERT JOSEPH BROWN, Port Lavaca, Tex.
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CLOVIS LOBO DE RESENDE, Belo Horizonte, Brazil
STEFAN NEDELTCHEFF DOBREFF, Reading, Pa.
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HENRY FRANCIS EICH, Arleta, Calif.
CHARLIE MILTON FARR, Kailua, Hawaii
JEROME MORTON FISCHER, New York, N. Y.
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WILLIAM CARL GARNER, Heber Springs, Ark.
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JAMES ARNOLD GREINER, Toledo, Ohio
CICERON ALOJANDRO GUERRERO, Quezon, Philippines
CHARLES ERNEST HAASS, Houston, Tex.
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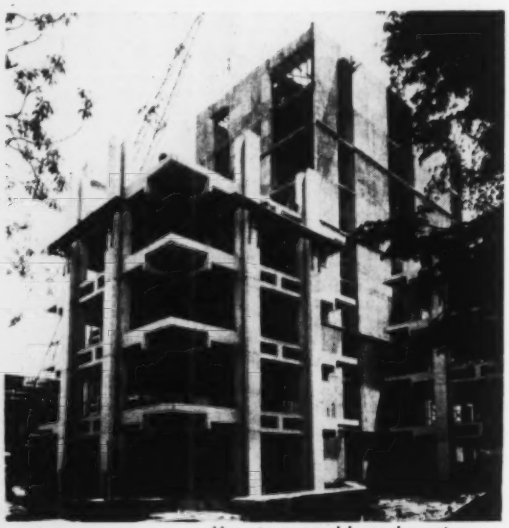
WILLIAM LOEWE HOLLANDER, Centralia, Mo.

(Continued on page 120)

STRESSTEEL was the solution to this Engineering Problem



Medical Research Center, University of Pennsylvania, Philadelphia.

Louis I. Kahn, Architect
Keast & Hood and Dr. August E. Komendant, Structural Engineers

Joseph A. Farrell, Inc., General Contractor

Atlantic Prestressed Concrete Co., concrete units.

THE PROBLEM: How to assemble and prestress in place, 8 precast concrete segments in each floor system of a 7 story clear-span Vierendeel frame building, with maximum efficiency and minimum cost.

THE SOLUTION: Post tension with STRESSTEEL, taking advantage of the inherent rigidity of STRESSTEEL Bars and the simplicity of STRESSTEEL Wedge Anchors.

The building consists of 3 wings, each 47 feet square, made up entirely of precast members surrounding a central unit of cast-in-place concrete. The framing in each floor required post-tensioning 2 beams made up of precast segments. STRESSTEEL Bars, 2 @ 1¼" ∅ and 3 @ 1¼" ∅ furnished a force of 575,000 lbs. per beam.

These bars were threaded through holes preformed in the interlocking precast segments by workmen operating from a scaffold suspended from the crane. STRESSTEEL Bars were simply and quickly tensioned with electrically operated hydraulic jacks and then pressure grouted.

In addition to precast applications, imaginative engineers are using STRESSTEEL Bars as the effective solution to many other problems. These high strength alloy steel bars are available in sizes up to 1¼" ∅ with recommended working stress up to 90,000 psi. Equipped with wedge or threaded anchors, STRESSTEEL Bars have been used for sheet piling ties in cofferdams, embedded ties for tainter gate trunnions, arch ties, buttress ties and many other unusual and special applications.

You will achieve superior results at substantial savings with STRESSTEEL because it is . . .

- High strength alloy steel
- Low in labor cost
- Low in initial cost
- Easy to tension

Are you working on a special anchorage, tie rod or foundation problem? STRESSTEEL'S high strength reinforcement, combined with the advantages of post-tensioned prestressing, may well be the optimum solution. Ask us.

Write for Technical Bulletin No. 2. **Member—Prestressed Concrete Institute**

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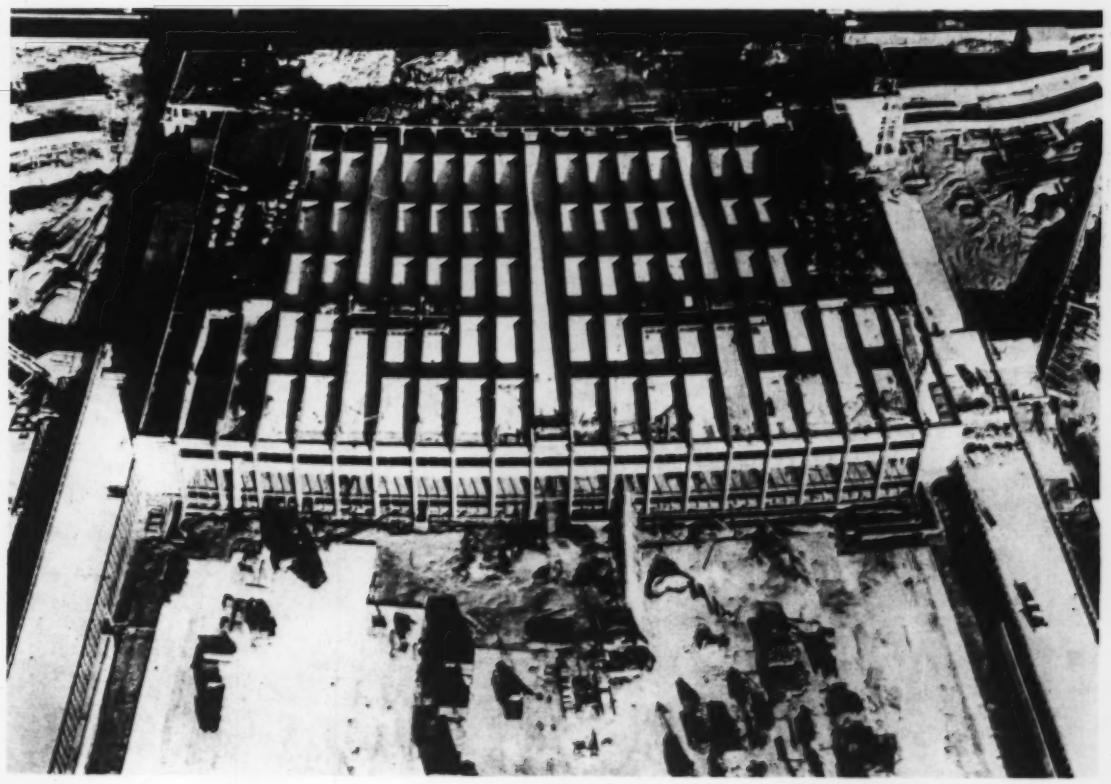
Controlled uniformity in lightweight concrete with PLASTIMENT

To overcome variations in ambient temperatures and to maintain specified design strengths, Plastiment Retarding Densifier was used in approximately 20,000 cu. yds. of lightweight concrete placed in the sprawling new $20-million Eastern Air Lines Terminal at New York's Idlewild Airport.

The terminal's 16 massive roof girders, spaced on 15 to 18-ft. centers, rise 9 ft. at the center of the span. Although only 126-ft. spans were required, it proved more economical to design continuous 230-ft. girders. Each continuous girder was cast as a single homogeneous member in a 10 to 12-hour working day. Plastiment increased workability and kept the mix plastic during the extended placement period preventing form deflection cracks and cold joints. Starting at the opposite ends of the form, concrete was fed alternately through side ports and consolidated by vibration. The quantity of Plastiment was varied according to ambient temperatures to produce dense, uniform quality concrete.

Usage of lightweight aggregate in the mix cut the deadweight of the structure (above the first-floor slab) approximately 22%. Specified 3-day strengths of 2,500 psi and 28-day strengths of 3,000 psi were exceeded. Rapid strength gain made possible early stripping of forms in spite of extreme set retardation.

Plastiment features are detailed in Bulletin PCD-59. Ask for your copy. District offices and dealers in principal cities; affiliate manufacturing companies around the world. In Canada, Sika Chemical of Canada, Ltd.; in Latin America, Sika, Panama, S. A.



Owner and Operator: Eastern Air Lines; Architect: The late Chester L. Churchill. Work is now being carried to completion by Albert C. Grey and associated architects and engineers; Consulting Engineers: Seelye, Stevenson, Value & Knecht; General Contractor: The Gilbane Building Company; Ready-mix Supplier: M. F. Hickey Company, Inc.; Photos: Rothschild Studios.

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PERMANENTLY YOURS: CAST IRON PIPE

Installed... it stays installed

One thing sure about cast iron pipe—once it's in the ground, it's there for keeps! Over 100 American utilities, having used cast iron pipe steadily for more than a century, can testify to that. And *modern* cast iron pipe gives you greater assurance than ever: great beam strength resists heavy surface traffic; tremendous load resistance absorbs even the most forceful pressures. In fact, when you select cast iron pipe, you can anticipate no major repairs in your water supply system for the next hundred years!

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A smooth coat of cement lining along the inner wall helps prevent the formation of flow-reducing particles. No matter how strong the water is, cast iron pipe always assures a free, steady flow.

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Bottle-tight, rubber-ring joints give you leak-proof protection at the most vulnerable points of your system. Vibrations, surface traffic and washouts present no problem to cast iron pipe. Inherent ruggedness . . . built to perform under all adverse underground conditions . . . repair-free service for at least a century—all good reasons why your choice should be that of water utility experts everywhere. America's greatest water carrier: cast iron pipe.

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

Men Available

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 27. Five years of experience, surveys, and designing, drafting and estimating, bridges, cofferdams, caissons, trackwork, cableways, docks, pressure vessels, structures for petroleum refineries, industrial buildings, highways, grading and drainage. Location desired, New York. C-518.

ENGINEER, A.M. ASCE, D.C.E., 30. Design and supervising the structural and architectural sides of various type of buildings. Presently in India. Location desired, U.S. C-519.

CIVIL ENGINEER OR FIELD ENGINEER, A.M. ASCE. B.S.C.E., 26. Five years of experience in construction supervision, engineering, and management as resident engineer of sewage treatment plant and sewer systems; project engineer of A. F. Copehart housing development; and designer of water and sewerage systems. Location desired, Washington, D. C.; Dallas, Tex. area; Florida or California. C-520.

CONSULTING STRUCTURAL ENGINEER, F. ASCE. B.S.C.E., 46. Ten years as structural designer on civil and military work; 5 years as architectural engineer designer of industrial, office and commercial buildings (private practice); 5 years as construction supervisor and manager (private practice); and 3 years as bridge designer. Location desired, South. C-521.

CIVIL ENGINEER, M. ASCE. B.S.C.E. and M.C.E., P.E. license, 20 years of diversified experience in consulting sanitary engineers and office. Teaching, construction of highways and oil refinery design. Location desired, New Jersey or New York Metropolitan area. C-524.

SOILS OR GEOLOGICAL ENGINEER, A.M. ASCE, B.A. and M.S. in geology 36. Eight years as soils engineer or highways and dam. Supervised soil and concrete tests in laboratory and field. Three years of experience as geologist on borings and tunnel construction. Location desired, eastern U.S. C-523.

EXECUTIVE POSITION OR PROFESSOR, F. ASCE, M.S., Ph.D., 39. Three and a half years in administrative position with architectural engineers plus 6 years as supervisor and designer with industrial engineers. Author of several articles and a book. Location desired, Midwest. C-929-Chicago.

PROFESSOR OR RESPONSIBLE SANITARY ENGINEERING POSITION IN INDUSTRY, M. ASCE, B.S.C.E., M.S., Ph.D., 40. Five years of experience in general civil engineering, $1\frac{1}{2}$ years of experience in teaching; and 8 years of design and research experience in sanitary engineering with consulting engineers and industry. Location desired, U.S. C-976-Chicago.

CIVIL ENGINEER, M. ASCE, A.M.I.C.E. (London), 31. Eleven years of general engineering experience ($4\frac{1}{2}$ years of them in North America); 4 years on railroad work, 5 years on highway work, 1 year with a contractor, and 1 year on hydro design. Location desired, Midwest. C-1046-Chicago.

SOILS ENGINEER, A.M. ASCE, B.S.C.E.—structures, M.S.—soil Mechanics, EIT Illinois, 29. Military obligation completed, $3\frac{1}{2}$ years as pilot and construction engineer in USAF. Two and a half years of varied civil engineering experience including 1 year with soils and foundation firm. Location desired, Midwest. C-1047-Chicago.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

DESIGNER OR FIELD ENGINEER, civil engineer, A.M. ASCE, registered Civil Engineer in California, 66. Ten years in charge of specifications, estimates, contracts, construction for test lab and concrete company; 3 years in charge of estimates, contracts, construction of highways, and 20 years as sales manager for cement manufacturer. Salary, $7,200 up a year. Location desired, San Francisco Bay Area. Se-754

DESIGNER OR SUPERINTENDENT, civil engineer, A.M. ASCE, registered Civil Engineer, Ore. Seven years of experience in construction encompassing grading and heavy industrial both engineering and craft supervision. Steam power plant experience. Foreign experience. Working knowledge of Spanish. Interested in construction of position with progressive firm. Se-713.

JR. CIVIL OR STRUCTURAL ENGINEER, civil engineer, Student Chapter ASCE, Tau Beta Pi, 21, will graduate June, 1960, with High Distinction. Prefer work in structural engineering. Salary, $6300 a year. Location desired, San Francisco Bay Area. Se-689.

STRUCTURAL DESIGNER, CHECKER, civil engineer, M. ASCE. Thoroughly experienced in all types of concrete design, steel structures for industrial purposes, schools, churches. Salary $6000 a year. Location desired, San Francisco. Se-664.

CIVIL ENGINEER, civil engineer, F ASCE, Civil Engineer License in California, 51. Fifteen years of experience supervising inspection, design, survey, maintenance and operation on buildings, grounds, utilities, streets, sewers, bridges, flood control projects, Army camps, colisum for counties, university. Self-employed. Salary $10,000 a year. Location desired, San Francisco Bay Area. Se-517.

DESIGNER AND SPECIFICATION WRITER, civil engineer, M. ASCE, professional Civil Engineer License in California, 43. Fifteen years of experience on design, field supervision, and specifications on industrial, commercial buildings for construction and architectural consultants. Also parttime lecturer on architecture. Salary, $9,600-$10,800 a year. Location desired, San Francisco Bay Area. Se-497.

MANAGEMENT SUPERVISOR, civil engineer, A.M. ASCE, 33. Own and operate construction consulting firm. Construction experience on dams, power house, industrial structures, schools, stores, roads, with field and office engineering and supervision. Salary open. Location desired, West. Se-480.

FIELD OR OFFICE ENGINEER, civil engineer A.M. ASCE, EIT, 29. One year as supervisor on construction of newspaper plant; 3 years' designing and drafting plans and specifications for commer-

FLUID MECHANICS ENGINEER

Education—MS or PhD with major in Fluid Mechanics with BS ME or ChE preferred.

Experience—1 to 2 years' experience or equivalent laboratory research in college work. Strong interest in research.

Nature of Work—Basic studies and applied research directed at improved process and product. Involves handling of fibers, natural and synthetic, in fluid streams to form products. Transport, turbulence, characteristics of free and submerged jets, flow through porous media and two phase flow.

Location—Research and Development Center, Neenah, Wisconsin.

Salary—Based on appraisal of qualifications. Commensurate with ability.

For detailed information and application form—write to

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CIVIL ENGINEERING APPOINTMENT: McMaster University

The Department of Civil Engineering and Engineering Mechanics solicits applications for a staff position in a new school with a stimulating research environment.

The candidate should possess a graduate degree (preferably the doctorate) based on specialization in structures or engineering mechanics, and some experience in lecturing and research direction. Duties will include undergraduate and graduate instruction, and good research facilities are available.

Appointment will be made at the rank of assistant or associate professor, depending upon qualifications and experience. Enquiries and the names of three references should be addressed to:

DR. J. W. HODGINS
Dean of Engineering
McMaster University
Hamilton, Ontario, Canada

cial, industrial and public buildings for consultants. Salary $800 per month. Location desired, West, or Overseas. Se-403.

SANITARY ENGINEER OR SALES, civil engineer, A.M. ASCE, 41. Eighteen years of progressive experience in all phases of sanitary engineering, including 6 years in sales and 8 years as supervisor. Specialist in water and sewage treatment plant design. Salary, $10,800 a year. Location desired, San Francisco Bay Area. Se-363.

DESIGNER, MSCE (sanitary engineering) F. ASCE, 58. Fifteen years of experience on design of reinforced concrete projects, structures, heavy foundations. For foreign governments on heavy industrial and residential buildings and mining industries. Salary, $8400 a year. Location desired, California. Se-1770.

FIELD OR OFFICE ENGINEER, civil engineer; M.ASCE. Professional Civil Engineer in California, 36. Twelve years of experience on erection procedures, methods, equipment, owner's representative, design, reports on bridges, hospitals, buildings for consulting engineers and government; 2 years on design of heating, ventilating, air conditioning for hospitals. Salary, $10,800 a year. Location desired, West. Se-332.

CONSTRUCTION SUPERINTENDENT M.ASCE, 60. Thirteen years of experience supervising construction of chemical process buildings, sewage pumping plants, AEC projects, public utility projects, for architects, engineers, public utilities. Salary, $6,600 a year. Se-102.

MATERIALS ENGINEER OR INSPECTOR, civil engineer, M.ASCE, 31. Five years of experience making laboratory test of materials, soil surveys, design, inspector on highway and bridge construction. Salary, $10,000 a year. Location desired, South America, Overseas. Se-1687.

Positions Available

CIVIL ENGINEER, registered, with capable background and client connections, interested in association with party ready to form a consulting business. Location, Maryland. W-8607.

ASSISTANT TO CHIEF ENGINEER in the field of concrete pressure pipe. Position will cover wide variety of operations, i.e. construction of new buildings and plant facilities, as well as the design of concrete pressure pipe. Salary open. Location, Midwest. W-8597.

DEVELOPMENT ENGINEER, civil or mechanical graduate, with at least 2 years of product design and development experience in concrete product fields. Salary, $8,000-$10,000 a year. Location, northern New Jersey. W-8561.

AIR POLLUTION CONTROLS SPECIALISTS, graduate civil, chemical, or mechanical engineers, to work in the study, development and application of measures for the control and elimination of air pollution health hazards. (*a*) Grade I, no experience required. Salary, $5,268-$6,390 a year. (*b*) Grade II, with 2 years of experience in air pollution control or related work, or equivalent education. Salary, $6,090-$7,772 a year. Location, Pennsylvania. W-8560.

CIVIL ENGINEER, graduate civil, with professional engineer's license. Must understand problems of topographical layout; sub-surface range; separation and disposal of water supply and wastes involving impounding basins and spray ponds; river intake; piling; reinforced concrete foundations for heavy equipment and for buildings; design of structures for support of vessels and drums; etc. Salary, $15,600 a year, possibly higher, depending upon background. Location, New York. W-8559.

STRUCTURAL AND HIGHWAY ENGINEERS with considerable design experience. Location, New York. W-8347.

ENGINEERS. (*a*) Engineers, C. E. degree required, for principal work assignments in hydrology, hydraulics and sanitary engineering fields with consulting firm in Midwest. Preference will be given for experience in a combination of two or more of the above fields. Salary open, depending on assignment. (*b*) Engineers, C. E. degree required, for work in field of foundations and soil mechanics. Preference will be given to man with 1 or 2 years of experience and specialized educational background. C-7932.

RESEARCH AND DESIGN ENGINEER, graduate structural or civil, B.S. or better; to 40; with 3 or more years of experience in steel and concrete design of structures and prestressed concrete and thin shell design. Will attend technical meetings, and speak frequently before engineering group. Must be research minded to develop methods of design of new structures in concrete and have the initiative and the ability to carry problems through. Should belong to engineering societies and have made contributions to technical publications. Salary, $9,000, plus depending on experience and ability. Employer might negotiate placement fee. Location, Chicago. C-7929.

HEAVY CONSTRUCTION SUPERINTENDENT, civil graduate with 5 to 10 years of experience in heavy construction, to take responsible charge of field operations and assist project manager in coordination and administration of entire waterfront construction projects. Salary, $9,600-$10,800 a year, depending on experience. Discuss payment of placement fee with employer. Location, southern California. Sj-5048.

CONSTRUCTION ENGINEER, civil engineer, 25-35, experienced in heavy construction, with ability to handle field engineering and layout, design falsework and concrete forms, job cost accounting, take-off and estimating. Salary, $7,200-$9,600 a year, depending on experience. Discuss payment of placement with employer. Location, California. Sj-5047.

DESIGNER, civil engineer or related degree (or equivalent experience), on the design and layout of channels, drains, basins and appurtenant structures and preparation of working drawings, specifications and estimates of quantities and costs. Location, Southern California. Sj-5019.

PROFESSORS, (*a*) Structural engineering, capable of teaching advanced strength of materials and ultimate strength design. (*b*) Highway engineering, to teach highway planning and design, traffic engineering. (*c*) Applied mathematics, to teach mathematics for engineers and related subjects. Full or associate professor, depending on qualifications. Doctor degree or equivalent experience given preference. Two years with overseas allowance, travel for family, country differential and allowances for post, quarters and education for children through twelfth grade. Project supported by U.S. college. Location, THAILAND. Sj-5014.

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Civil
Hydraulic
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GS-7, $5430 per annum
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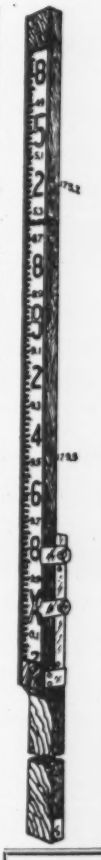

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MATERIALS INSPECTORS
WANTED

TVA has openings on a large hydro- and steam-electric program for experienced civil, structural, electrical, and mechanical engineers in its Division of Design located in Knoxville, Tennessee, and for materials engineers and inspectors of materials located in various district offices, principally in the north and east.

These positions are at the following grades and rates of pay:

Civil, Mechanical, Electrical, and Materials Engineers, grades SD-2 and -3 $6200–$7150

Inspectors of Materials, grades SE-5 and -6 $5825–$6625

The engineering jobs require a college degree in engineering or its equivalent with from one to three years of experience in design and specification work, or in inspection and testing work for materials engineers. The inspector of materials jobs require some college training in engineering or equivalent training and experience in making engineering inspection and tests of mechanical, structural, and electrical equipment and materials.

All jobs carry automatic within-grade increases for satisfactory service, liberal vacation leave, sick leave, and retirement, hospitalization, and insurance benefits.

Write to:

TENNESSEE VALLEY AUTHORITY
Division of Personnel
Knoxville, Tennessee

RECENT BOOKS

(added to the Engineering Societies Library)

Advances in Geophysics (Atmospheric Diffusion and Air Pollution)

Volume 6

The present status and future possibilities of atmospheric diffusion research are reported in this volume. General surveys of the atmospheric diffusion of pollutants and recent findings on atmospheric turbulence are followed by papers on the theory of turbulent diffusion, the diffusion of heavy or finite particles, transfer through the troposphere and stratosphere, and the effects of thermal stratification on diffusion. Pollution patterns from point and area sources are then discussed. The subject index is brief, referring only to the titles of the articles. (Proceedings of a symposium held at Oxford, England in 1958. Edited by H. E. Landsberg. Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y., 1959. 471 pp., bound. $12.00.)

Aerial Photographic Interpretation

The fundamentals of aerial photographic theory and technique are presented, followed by a survey and discussion of the various landforms and rock types, and the practical applications of photographic interpretation in a wide variety of engineering and scientific fields. Elements in the photograph such as unit land form, surface drainage, erosion, gray tones, vegetation, and land use, in addition to a comprehensive lexicon of these landforms and geomorphology in the photograph are dealt with. These are all then applied to solve problems in such fields as civil and water supply engineering, mineral exploration, forestry, agriculture, and urban and regional planning. (By Donald R. Lueder. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y., 1959. 462 pp., bound. $17.50.)

The Corrosion and Oxidation of Metals

This work represents the conclusions reached by the author in his investigations into corrosion, as well as providing a summary of other experimental work which has influenced him in reaching these conclusions. The topics discussed include simple oxidation of single metals, electrochemical corrosion, soluble inhibitors, bimetallic contacts and crevice corrosion, anodic corrosion and passivation, hydrogen evolution and acid corrosion, crystallographic corrosion, and atmospheric corrosion. In addition a number of industrial aspects relating to boilers and condensers and to various types of coatings are discussed. (By Ulick R. Evans. St. Martin's Press, 175 Fifth Avenue, New York 10, N. Y. 1959. 1094 pp., bound. $25.00.)

Examples of the Design of Reinforced Concrete Buildings

In the first section of the book the author gives design calculations of bending-moment factors and structural parts, based on British Standard Codes and data for design. The second part deals with details in the design of a typical multiple-story building which has been planned to incorporate as many of the matters treated in the code as is practicable. New material includes revised bending-moment factors; the load-factor method applied to the design of structural parts subject to bending; concentrated loads on slabs spinning in one or two directions, and flat-slab floors as parts of a frame. (By Charles E. Reynolds. Concrete Publications Ltd., 14 Dartmouth Street, London, S.W. 1, England, 1959. 265 pp., bound. $3.00.)

The Highway and the Landscape

A unique discussion of the modern highway viewed as a public structure serving both the motorist and the community, and affecting the pattern of future land use and landscape conservation. The thirteen contributors are experts in engineering and landscape architecture. Their comments which will be of interest to both rural and urban planners, taxpayers, civic groups and motorists, are timely in view of the current extensive highway building program in the U.S. (Edited by W. Brewster Snow. Rutgers University Press, New Brunswick, N. J., 1959. 230 pp., bound. $5.00.)

Library Service

Engineering Societies Library books except bibliographies, handbooks, and other reference publications, may be borrowed by mail by (the Society's initials, eg. ASCE) members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Theory of Plants and Shells

Second Edition

A thorough revision of a monograph which discusses the deformation of bodies in which one dimension (the thickness of a plate or shell) can be considered as small in comparison with the other dimensions. This edition has added a new section on the deflection of plates owing to the transverse shear, and a special chapter on the bending of anisotropic plates. The chapter on nonlinear bending of plates is considerably enlarged, while the three chapters on shell theory now include the use of Pucher's stress function, and outline the design of cylindrical roof shells. (By S. Timoshenko and S. Woinowsky-Krieger. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1959. 580 pp., bound. $15.00.)

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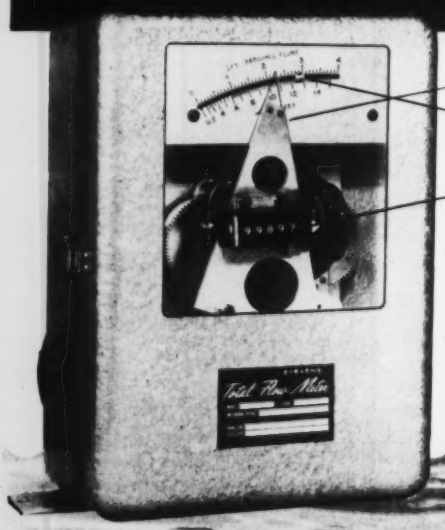

Low-cost meter provides essential flow data for operation of sewage treatment plants

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Mechanically operated meter provides essential data in measurement of sewage, industrial wastes, irrigation water or other liquids flowing in open channels. Standard meter gives direct flow reading in cu. ft./sec. and totalizes volume in cu. ft. Readings are easily converted to other units of measurement.

The instrument is designed for use with Parshall flumes and various weirs. It is entirely mechanically operated, will function without attention for eight-day intervals, and is easy to install on table, shelf or wall. If a graphic record is desired, the meter can be used with a Stevens Type F Recorder. Write for Stevens Hydrologic Instrument Short Form Catalog No. 23, and for Bulletin 28 which describes the Model 60M meter in detail.

HYDROGRAPHIC DATA BOOK—Valuable reference file. 124 pages of technical data on recorder installations, plus a number of useful tables and conversion tables. $1 copy. (No C.O.D.'s)

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Specialists in hydrologic instruments for over half a century

Suspended Roof for New College Gymnasium

"Column-free on the inside" is the way the architect describes this exciting and wholly utilitarian structure. It is the Physical Education Building of the Central Washington College of Education, Ellensburg, Washington. It is 150 ft wide by 390 ft long and contains, among other things, a main gymnasium, upper gymnasium, field house, swimming pool, apparatus room, two four-wall handball courts, two classrooms, 14 offices and, locker rooms, dressing rooms, etc.

The suspended roof is actually floating, being slip-fastened to the exterior walls. There are twenty-eight 80-ft high prestressed concrete pylons. Each supports two pairs of 1-5/16 in. prestretched, galvanized bridge strands, which suspend the entire roof structure. The 56 cables, averaging 404 ft in length, were prestretched and accurately marked for all attachment points at Roebling's plant. This resulted in an easy, economical field erection procedure.

Spectacular new Health and Physical Education Building, Central Washington College of Education at Ellensburg, Washington.
Architect: Ralph Burkhard, A.I.A., Seattle
Structural Engineers: Anderson, Birkeland, Anderson, Tacoma
General Contractor: Earley Construction Company, Tacoma
Prestressed Concrete Fabricator: Concrete Technology Corp., Tacoma

Its 99,500 sq ft of floor space cost $14.15 per sq ft, including architect's fee and 4% sales tax, which is below average for a building of this size.

These basic details are indicative of the wide and varied benefits common to all suspended roof structures. Airline terminals and hangars, plants, gymnasiums, civic auditoriums – all are enjoying the free space afforded by suspended roofs.

Roebling's great experience with steel in tension leads naturally to its active role in the suspended roof field. Our findings, theories and interest in its every phase are offered to you at any time. Should you wish further details on this particular structure, or information of any nature dealing with suspended roofs, please do not hesitate to write Roebling's Bridge Division, Trenton 2, New Jersey.

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

RPC-4000 Electronic Computing System

A NEW, FULLY TRANSISTORIZED, general purpose digital electronic computing system which can serve both scientific and business data processing needs has been announced.

The RPC-4000 computing system is capable of operating on 9-digit numbers at rates up to 240,000 operations per minute. Overall high computing speed results from: high operating rates; versatile command list (42 in all) including commands which facilitate double precision and floating point operations as well as a special command designed to speed-up input and output operations; an index register that allows high-speed instruction modification; repeat execution feature; high-speed input-output equipment and an 8-word accumulator for block operation (eight sums may be accumulated simultaneously).

The magnetic drum memory section incorporates many new design features. The drum is tapered and floats on a cushion of air; when the machine is idle, it rests safely away from the heads. Air pressure automatically raises the drum to correct operating position when power is turned on. The memory has a storage capacity of 8,008 words (word length is 32 usable bits, accommodating a 9-decimal digit number), allowing great problem-solving flexibility. A variety of programs can be stored permanently for instant access when needed. Average access time to the main storage is 8.5 milliseconds. **Data Processing Div., Royal McBee Corp., CE-3, Port Chester, N. Y.**

RPC-4000

Planetary Drive Cable Control Units

TWO NEW PLANETARY-DRIVE cable control units—the front-mounted Model 160 and the rear-mounted Model 260—now are available for the TD-25 crawler.

The single-drum Model 160, with a brake capacity of 9,000-lb line pull at bare drum speed, is a heavy-duty, fast-acting and easy-operating control. A two-piece brake and clutch band construction assures longer clutch and brake life and provides greater flexibility and more accurate braking. Both brake and clutch bands have pick up springs at the top half of the bands to keep free line pull to a minimum and reduce heat and wear.

The double-drum Model 260 represents a new concept in cable control units, employing a ring gear and pinion to drive a four-gear planetary system for each cable drum. High-strength, light-weight nodular iron major castings, with a unit weight of 2,260 lb are used. The cable drums can handle 248 ft of up to ⅝-in. cable, attaining a full drum speed up to 650 ft per minute and a bare drum speed up to 412 ft per minute. **International Harvester Co., CE-3, 180 North Michigan Ave., Chicago 1, Ill.**

High Capacity Conveyor

DESIGNED PRIMARILY TO WORK with auger drills in the mining of coal, a new high capacity conveyor can be attached to the auger so that it moves as the auger is moved to the next location. The equipment is rubber mounted and has discharge heights ranging from 10 to 17 ft; flight speed is 120 ft per min.

Optional features include hydraulic steering, hoisting and chute swing. A choice of electric motor, gasoline or diesel engine is available to fit the job and location. **The Fairfield Engineering Co., CE-3, Marion, Ohio.**

Uniweld Used in Resurfacing Concrete Flooring

A MAJOR DEPARTMENT STORE recently used Uniweld as "insurance" in the resurfacing of 40,000 sq ft of questionable 33-year-old concrete flooring for a new long-term tenant, who desired to install a number of heavy business machines, the weight and vibration of which might deteriorate the old floor topping. Since it was also desired to install new electrical conduits in the floor, the management decided to remove the existing topping and replace it, using the best available method to assure strength and permanence of the new concrete layer.

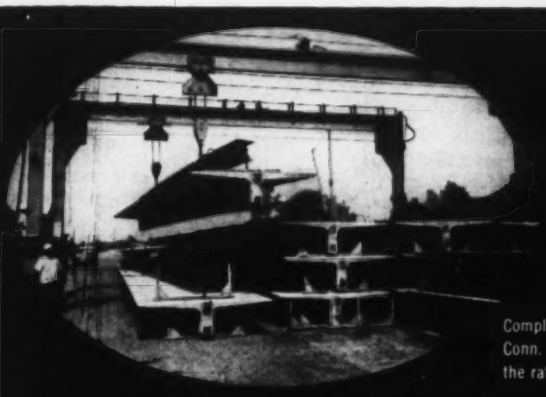
As the most economical method suggested was the use of a concrete bonding compound, Uniweld was recommended as the most effective in assuring a permanent, high strength joint between the new concrete and the existing sub-floor. It forms a permanent, waterproof, monolithic bond between newly poured wet concrete and already cured concrete.

The first step in the remodeling was the removal of the old two-in. concrete topping. Since Uniweld forms a permanent bond without any need for veeing, notching or roughening, it was only necessary to remove the debris and loose particles before coating the sub-floor with the welding agent. The two separate Uniweld components were then mixed in equal volume to start the curing cycle. **Permagile Corporation of America, CE-3, 34-43 56th St., Woodside, N. Y.**

Diaphragm Pump

THIS LIGHTWEIGHT, HEAVY-DUTY PUMP is designed for ditch or trench work where seepage is soupy or where exceptional air handling capacity is required. Extremely portable, weighing only 165 lb, the 2-in. Skwee-Gee has excellent priming characteristics which makes it ideal also for high lift applications or small well point dewatering jobs. It features an exclusive gear reduction arrangement with vertical stroke plunger which results in pump diaphragm receiving only straight up and down stroke, thus greatly reducing wear and increasing efficiency. **Construction Machinery Co., CE-3, Waterloo, Iowa.**

PRESTRESSED CONCRETE "T" BEAMS FOR UNIQUE PARKING DECK



Completed "T" beams at C. W. Blakeslee's Hamden, Conn. plant. They were shipped to the job site at the rate of 18 per day on trucks with special frames.

Placing beams at job site in Springfield, Mass. With each beam set at a slightly different angle, there is no more than a 4 percent grade in any part of the structure. Each beam is 8 ft. wide at the top of the "T" and only 8 in. wide at the stem.

• This new parking deck for the Forbes & Wallace department store is a striking example of the opportunities that prestressed concrete offers designers and builders.

Gage and Martinson's unique design utilizes 182 ten-ton prestressed concrete "T" beams, whose 54′ lengths permit a completely post-free parking facility. Ease and speed of erecting the prefabricated concrete decks made it possible for the Ley Construction Company to open the 3½ story structure for business just seven months after breaking ground.

The manufacturer of these beams, C. W. Blakeslee & Sons, Inc. uses Lehigh Early Strength Cement for maximum production efficiency in their prestressing plant. Units are completed quickly, ready for trucking to the job site as needed.

This is typical of the advantages of Lehigh Early Strength Cement in modern concrete construction. Lehigh Portland Cement Company, Allentown, Pa.

LEHIGH CEMENTS

The 54′ spans provide ample room for angle parking on both sides of every level plus a wide center aisle for one-way traffic flow. Note complete absence of posts. The 3½ story structure can park about 350 cars at one time, and 2,000 cars in a single day.

OWNER: Forbes & Wallace, Springfield, Mass.

ENGINEER: Gage & Martinson, New York City

GENERAL CONTRACTOR: Ley Construction Co., Springfield, Mass.

MANUFACTURER OF PRESTRESSED BEAMS: C. W. Blakeslee & Sons, Inc., New Haven, Conn.

READY MIX CONCRETE FOR POURED-IN-PLACE CONCRETE: Valentine Concrete Co. Springfield, Mass.

(continued)

New Transistorized Instruments

REDUCTION OF MAINTENANCE COSTS by 90% were reported in extensive field tests of new transistorized pipe and cable finder instruments.

Hermetically sealed transistors and printed circuits in the 1960 model M-Scope Pipe Finders proved to be superior to vacuum tubes and circuits in conventional models. In addition, battery life of the units averages more than 1500 hours of continuous operation.

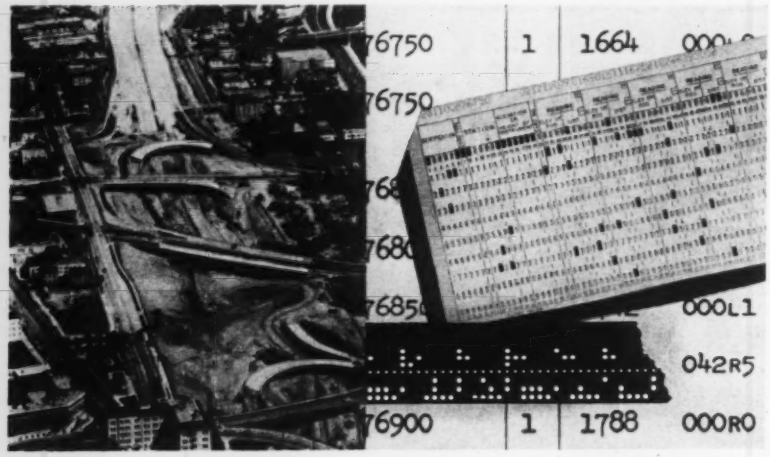
Other features of the pipe and cable locator include indestructible fiberglass cases, single turn anodized aluminum loop antennas, built-in battery testers and a detachable carrying belt for drop-handle operation. **Fisher Research Laboratory, Inc., CE-3, Palo Alto, Calif.**

Portable X-Ray Equipment

X-RAY INSPECTION OF PIPELINE section and "window welds" is now more easily accomplished with the use of new lightweight, portable x-ray equipment.

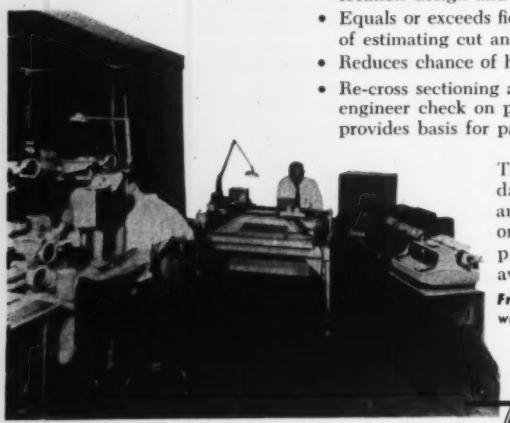
In this setup, the window welds being inspected were located at a pipeline vertical offset which brought the pipe to within only a few feet of the surface. City block-long distances of pipe were installed at depths varying from a few feet to 10 feet below the street surface. Use of high voltage portable x-ray equipment like the LX-140 unit makes inspection of these weldments possible in places where larger, bulkier x-ray equipment would be impractical.

Simplified controls on the LX-140 enable even the most inexperienced personnel to learn its operation in just a few minutes of instruction, the company claims. A continuous range of 70 to 140 kvp is available. Radiographs with 2% sensitivity and 1.5 density can be produced with 1½ minute exposure through 1¼ in. of steel. **General Electric Co., X-Ray Department, CE-3, 4855 West Electric Ave., Milwaukee, Wis.**



New Fairchild Service provides cross section and profile data in DIGITAL FORM *automatically!*

- Saves time and money in highway and railroad location design and construction.
- Equals or exceeds field accuracy of estimating cut and fill.
- Reduces chance of human error.
- Re-cross sectioning at periodic intervals gives engineer check on progress of earthmoving; provides basis for paying contractor.



The recorded terrain output data is automatically typed and simultaneously produced on punched cards. Punched paper tape output is also available.

***Free brochure!** Phone, wire or write your nearest Fairchild office.*

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Batching Plant Saves On Erection Costs

A PRE-MIX CONCRETE batching plant assembled or disassembled in only one day saves 50% of time and erection costs on Indiana state highway widening projects for Montpelier Stone Co.

After supplying 6700 cu yd of concrete for 11 miles of widening, the plant was

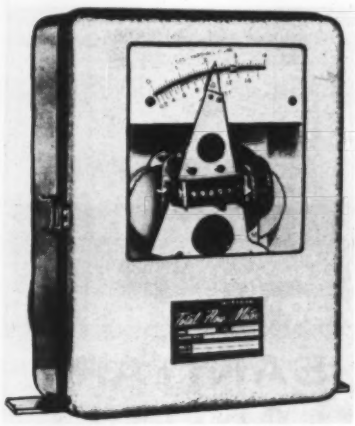
Saves Erection Costs

disassembled in one day and moved to another location for an additional 10 miles of highway concrete. Operating 9 to 10 hours a day, it batches an average of 60 yd per hour of pre-mix concrete with plant output governed by required mixing time and capacity. Cement and aggregate batching is fully automatic; one man sets the batching weights and operates the mixing controls. **Noble Company, CE-3, 1860 7th St., Oakland, Calif.**

Total Flow Meter

A NEW LOW COST Stevens Total Flow Meter designed to measure flow of sewage, industrial wastes, irrigation water and other liquid flowing in open channels, is now available. Lightweight, portable and simple to install, the Model 60 M Total Flow Meter has been especially designed for low initial cost and dependable service.

Total volume of flow through standard weirs or Parshall flumes is read from a counter-totalizer while instantaneous rate of low and head are indicated by a pointer and scale. A red index sliding on the



Low Cost

indicator scale and driven by the pointer indicates peak flow. Total volume that has passed through the Parshall flume or weir is registered in cubic feet by five digits on a counter and two on a calibrated disk. Flow indication is in cubic feet per second. Instructions accompanying the instrument include simple formulas for converting the totalizer and flow scale readings to other volume and flow units such as mgd, gpm and acre feet. The meter is entirely mechanically operated. Cam and index pointer are activated by float action and the integrator disk is driven by a spring clock motor. It will operate without attention for eight days. **Leupold & Stevens Instruments, Inc., CE-3, 4445 N.E. Glison, Portland 13, Ore.**

High Speed Terrazzo Grinder

RECENTLY PUT ON THE MARKET, the 1-hp High Speed Terrazzo Grinder contains a fully enclosed motor, mounted on a four-leg caster with composition casters to prevent scratching the floor. A lightweight, 10-ft long flexible shaft gives the machine good maneuverability and convenience on the job.

A variety of accessories are available, all equipped with Quick-Change Connectors making it possible to change from wet to dry Angle Spindles to Straight Grinding Spindles or Cove Base Grinding Heads in a few seconds. **Wyzenbeek & Staff, Inc., CE-3, 223 N. California Ave., Chicago 12, Ill.**

High Capacity Belt Loader

HAVING A THIRTY-FOOT conveyor that reaches 15½ ft high at the discharge end, the Jeb-Loader, according to actual production records, can cast up to 1750 yd an hour and load up to 800 yd an hour. A 32-in. dia cutting disc feeds material to a trough-shaped belt, which travels at

(Continued on page 132)

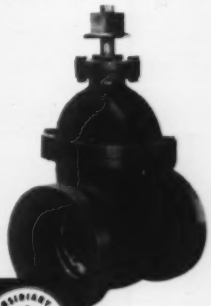
This Changing World

For hundreds of years, the fastest Man could travel was by riding a running horse at about 35 miles per hour. In 1830 the steam engine was invented, and then in 1910 the airplane which today travels at over 600 miles per hour. Man's weapons have changed from a slingshot to a spear to a bow-and-arrow to gun-powder to nuclear bombs. The only thing which never changes is change itself . . . change goes on almost continuously in myriad ways.

American cities have been steadily increasing in population and likewise spreading out into suburbs and "suburbs of suburbs". So more water is needed and distribution mains need to be longer with more valves and fire hydrants and more footage of main per customer. Engineering experts agree that to give adequate service, U. S. water and sewage facilities today need to be doubled!

Why do so many people face this spectacle of almost continuous and eternal change with a stoical indifference which history shows often has been an obstacle in the path of progress? Why not ask John Q. Public for advice? He might be flattered. He might realize that the water problem is his problem too, and become more interested in its solution.

This series is an attempt to put into words some appreciation of the water works men of the United States.



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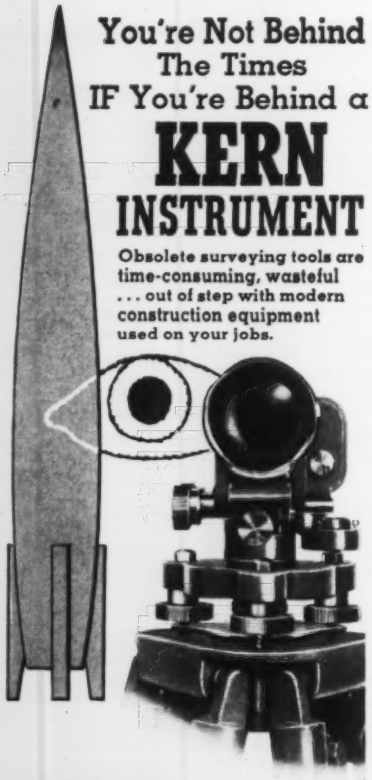

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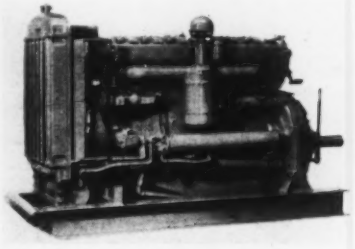
EQUIPMENT MATERIALS and METHODS

(continued)

614 ft per minute. The belt is kept free of clinging dirt by scrapers bolted to the conveyor frame and large crowned pulleys keep the belt centered while vertical guide rollers protect the edges of the wide belt. **Jebco, Inc., CE-3, Blair, Neb.**

New Engine Series

ACCORDING TO THE MANUFACTURER, the MP Series diesel engines are designed to put more power into a job. It is claimed that the diesels have the high rising torque necessary to take hold of a load and really hang on, a lugging power which helps keep equipment at the right operating speed for efficient production.



More Power Into Job

The engines and power units are available in sizes from 105 hp to 320 hp and generator sets are available in capacities from 60 kw to 188 kw. Dual-fuel models and Mech-Elec units, capable of delivering mechanical and electric power simultaneously, are also available. **Murphy Diesel Company, CE-3, 5317 W. Burnham St., Milwaukee 19, Wis.**

Road Grader Tire

A NEW ROAD GRADER TIRE with improved traction and wear characteristics has been introduced. Called the "Power Grader", it has an all Nylon cord body that withstands double the shock of ordinary grader tires, according to the manufacturer.

Extra-large tapered cleats that dig into the soil prevent slippage and its open center tread design promotes better cleaning. It is stated that the new tire resists bruising and flex breaks better than previous grader tires and its carcass outwears even its extra-thick tread, making possible repeated retreads. **B. F. Goodrich Tire Co., CE-3, 500 S. Main St., Akron 18, Ohio.**

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JOB-SITE CONCRETE TESTER FT 20-E

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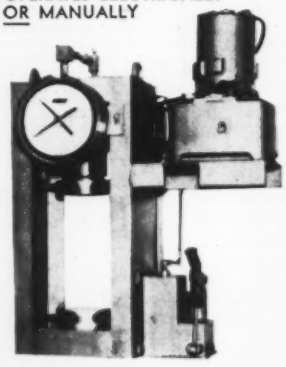

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EQUIPMENT MATERIALS and METHODS

(continued)

Commando Prime Mover

ONE OF THE FEATURES of the Commando Prime Mover is its shuttle transmission —a split torque drive arrangement that permits full power hydraulic creep, solid direct-drive or torque converter drive. It is the first and only power train that combines the outstanding advantages of high speed truck operation, plus the high torque and low speed of a tractor, the manufacturer states.

Turning in a 24-ft circle, the machine is available in 2 or 4 wheel drive. Speeds range from a controlled creep at full

Shuttle Transmission

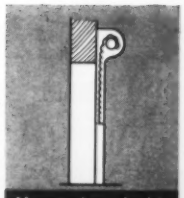
throttle starting at 0 mph up to 35 mph. Some of the Uni-Tools available are for the Commando, which can be used singly or in combination with the machine, are Hydra-Hammer and the Backhoe. The Hydra-Hammer, a powerful, fast breaker-tamper-pile driver, handles concrete breaking, cuts asphalt and tamps fill. It works the full machine width without tilting the tower and can tamp a swath 10-ft wide and has creep speeds from 0 to 100 fmp. The Backhoe digs 12½-ft deep in any position of a 190-deg swing. **Ottawa Steel Division, Young Spring & Wire Corporation, CE-3, Ottawa, Kan.**

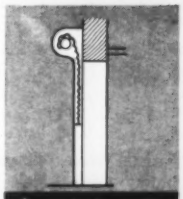
New Drilling Tool

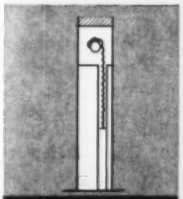
ONE-INCH-A-MINUTE speeds in drilling holes in concrete, regardless of the size of hole, have been attained with a new drilling tool which combines rotary action with rapid "jack-hammer" blows. The pounding-action of the tool operates at the rate of 4,000 to 7,000 impulses a minute while the drill bit revolves at 650 to 1200 rpm.

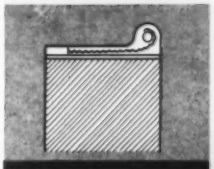
By combining the rock-shattering action of the star drill and mallet with the usual drill's rotary action, the company has developed a tool that has incredible hole-making speed, the manufacturer states. The Roto-Imp even cuts through

(*Continued on page 134*)

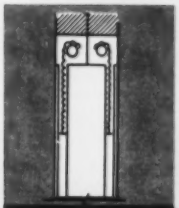

Mounted on inside wall; coils above the doorway.


On outside wall; leaves all ceiling space clear.

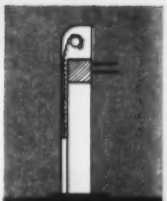

Hood under lintel or concealed in the wall.

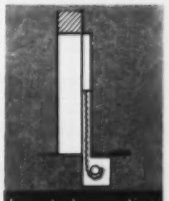

Horizontal mounting (ventilator, observatory or similar openings).

Sloping doorway (as for hoppers, chutes, etc.).


Kinnear Steel Rolling Fire Doors on either side of wall.*

Hood above roof or upper floor (no headroom needed).


Hood above lintel or atop wall (permits low ceiling).


Inverted mounting (door coils below the sill level).

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Extra-heavy galvanizing (1.25 oz. pure zinc per sq. ft. of metal, ASTM standards) gives Kinnear Rolling Doors lasting resistance to corrosion. Built any size, of steel, aluminum, or other metals, with motor or manual operation, for old or new construction. Write for full information!

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* Or a Kinnear Rolling Door and a Kinnear Rolling Grille (a coiling upward-acting "open-work" of steel bars and links that protects without blocking light, air or vision).

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Offices and Agents in All Principal Cities
FACTORIES: 1080-90 Fields Ave., Columbus 16, Ohio; 1742 Yosemite Ave., San Francisco 24, Calif.

reinforcing bars and hi-carbon twisted wire mesh imbedded in concrete.

Despite the fact that the tool can drill holes from ½ in. to 4 in. in dia., it is readily portable, weighs only 30 lb, and operates on 115 volt household current or from a small portable 1.5 kw gasoline generator, either AC or DC current. **Bill Jack Scientific Instrument Co., CE-3, Solana Beach, Calif.**

Headed Concrete Anchor

A NEW TYPE OF headed concrete anchor, believed to be the first design with known holding values and tensile properties, has been developed. Designated Type H-4, the anchor is a straight headed bar of cold finished low carbon steel, which can be welded in a fraction of a second with the lightweight Nelson stud welding gun.

Tests showed that the upset head significantly increased the holding power of this anchor, keeping it in place in the concrete even after the bond was broken between concrete and the anchor. Relative shank and head diameters of the anchor also were determined by tests. After a certain point, greater anchor length did not increase holding power. **Nelson Stud Welding Division, Gregory Industries, Inc., Lorain, Ohio.**

Greater Holding Power

Drill Rig

DESIGNED FOR MASS DRILLING with a minimum of set-up and breakdown time, a unique drill rig speeds along the job of drilling anchor bolt holes in the spillway face of the Thomaston Dam, Thomaston, Conn.

The 16-ft long, 7-ft wide platform rides up and down a 30-ft tower suspended from a crane boom; a Ty-Sa-Man bar welded to each end of the platform serves as a drill mount. Two TM-450 drifters drill 14-ft holes on 4-ft centers at an average rate of 500 ft per 8-hr day.

The rig starts at the top of the cliff, where the first two holes are drilled; then the platform is lowered 4 ft and a second pair of holes is drilled. When that portion is completed, the crane moves horizontally 5 ft, the platform is raised to the top and the process is repeated. **Joy Manufacturing Co., CE-3, Dept. 8, Oliver Bldg., Pittsburgh 22, Pa.**

Close Roofer-Supplier Timing Cuts Job

CUTTING A JOB THAT normally takes four days to six hours, with a saving in labor and equipment rental of $540 was the recent feat of J. P. Patti Roofing Co., Lodi, N. J. This was accomplished by unloading, raising and placing 79,000 sq ft of 1½-in. Fiberglass roof insulation in six and one-quarter hours.

In an attempt to cut costs, Patti obtained from Owens-Corning a guarantee of delivery of the entire shipment at a specific day and time. With this guarantee, and close timing with men, material and equipment, he hoped to do the job in less than a day.

Everything was ready for the insulation when it arrived when promised, packed 7 wrapped units of 4 sheets to a pallet. A 60-ft crane raised 2 pallets at a time directly from the trailers. As each of the 8 trucks was half empty, another was placed and stripped for unloading. It took an average of 2 minutes for each hoist, containing 2 pallets totalling 448 sq ft of insulation. On the roof deck, the pallets were immediately distributed for later installation by a forklift truck. **Owens-Corning Fiberglas Corp., CE-3, National Bank Bldg., Toledo 1, Ohio.**

Polyethylene Film

MORE THAN 900,000 SQ FT of polyethylene film has been laid beneath the foundations of Northwest Orient Airlines' new $18,000,000 general office and overhaul base at Wold-Chamberlain Field, Minneapolis-St. Paul, resulting in savings of thousands of dollars in maintenance and repair costs.

As few as three men are required to unroll the Visqueen film in 14-ft widths onto the bare earth floor. A reinforcing frame-work is then placed in position and the concrete slabs poured directly onto the film. **Plastics Division, Visking Company Division of Union Carbide Corp., CE-3, 30 E. 42nd St., New York 17, N. Y.**

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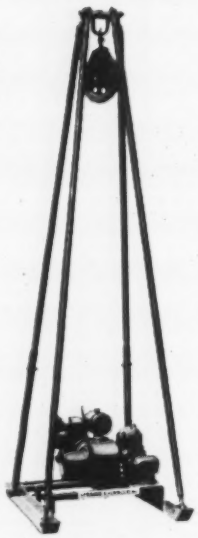

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EQUIPMENT MATERIALS and METHODS

(continued)

The Wheeled Traxcavator

MAJOR FEATURES AND PRODUCT details of the Cat No. 944 Traxcavator, first of an all-new line of wheel loaders, have been announced.

The most apparent feature of the machine is the locating of all lift arms and hydraulic cylinders ahead of the operator's compartment. This is the first rubber-tired loader "designed from the ground up" to solve this safety problem, according to the manufacturer.

Powered by either a gasoline or diesel engine, the No. 944 is fitted with a 2 cu

All-New Line

yd capacity bucket as standard equipment. Both the gasoline and diesel engines are rated at 105 net hp; the maximum rating of the D330 Diesel Engine used is 135 hp.

High productive ability of the new unit results from the combination of power shift transmission, which permits split-second shifting into forward or reverse gear; a high capacity hydraulic system that delivers full hydraulic power during critical loading phases; and a high degree of machine stability in all conditions. **Caterpillar Tractor Co., CE-3, Peoria, Ill.**

Large Size Structural Tubing

NEW DESIGN FREEDOM IS provided by factory-fabricated large-size square and rectangular structural steel tubing available in girths and thicknesses to meet exact requirements of architects and structural engineers.

According to the manufacturer, the de-

(Continued on page 136)

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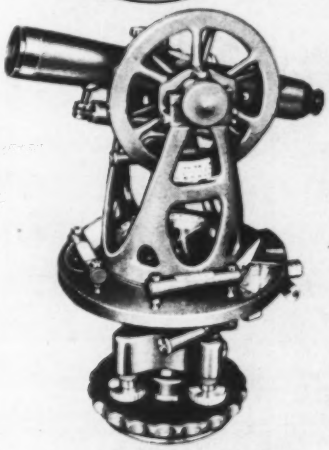
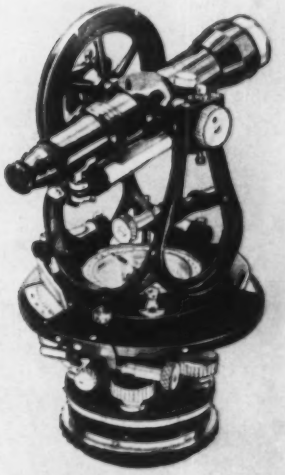


PATH



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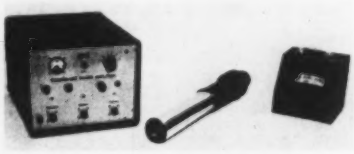
sign and use possibilities of Espro structural steel tubing are unlimited. Popular architectural applications include structural columns, beams, window mullions, canopy supports, stair stringers, columns for lift slabs, and steel buildings.

Smooth exterior surfaces on all four sides of the tubing are easy to paint and do not hold dust. When left exposed the columns and beams provide stylish, rectilinear members, without the expense of costly falsework. **Espro Tubing Division of Union Asbestos & Rubber Co., CE-3, Chicago, Ill.**

Electronic Auto-Collimator

THE DEVELOPMENT OF AN Electronic Auto-Collimator, which is said to be capable of measuring the tilt of a reflective surface with respect to the Auto-Collimator axis to the highest degree of sensitivity and accuracy ever achieved, has been announced.

It is further stated that the instrument is ideal for checking flatness of surface plates, straightness of machine toll ways,



Three Components Comprise Instrument

run-out of precision bearings, and for monitoring drift of gyros.

Three components comprise the company's new development: a sensing unit, a power amplifier, and an indicator. The sensing unit has an indicating range of 50 sec (plus or minus 25 sec), with a working distance of up to 30 ft between sensing unit and reflecting surface. The power amplifier's characteristics include a required power input of 115 volts, 60 cycles, 150 watts. The power output is suitable for chart recording and, after suitable amplification, for servo-system feed. The indicator's sensitivity selection has a 3-position switch with ranges of plus and minus 1, 10 and 25 sec. **Keuffel & Esser Co., CE-3, Third and Adams Streets, Hoboken, N.J.**

Foamsil

CONSOLIDATED EDISON'S NEW 500-ft chimney at their Arthur Kill Station on Staten Island, New York, incorporates what the M. W. Kellogg Co., its builder, refers to as, "A significant development in the design of concrete chimneys."

The big problem in concrete chimney operation has been protection of the concrete structure of the chimney from the deterioration caused by high temperature gases.

The formerly used insulation has been replaced with a new foamed silica material, Foamsil, a material which is 99% pure fused silica glass; it is highly resistant to all commonly used industrial acids. Its sealed cellular structure makes it impermeable to moisture or vapor.

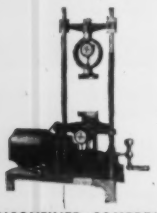
The side of the chimney was coated with acid-resistant bituminous compound and 2-in. thick blocks of Foamsil applied against this. Pennsalt Chemicals Synar silica cement was used as adhesive and joint sealer. A half-inch air space was left and an interior lining of one course of acid-resistant brick was then erected, principally to protect the Foamsil, against abrasion. **Pittsburgh Corning Corp., CE-3, One Gateway Center, Pittsburgh 22, Pa.**

CONBEL
Consolidation Tester
Capacities to 10,000 lbs.

TESTING SOIL SAMPLES?

. . . take a closer look at the Tinius Olsen line of K-W Physical Soil Testing Machines. These rugged, portable units are designed for convenient "table top" operation in the lab or on the job site.

Get the full story. Write today for Bulletin 50-A.



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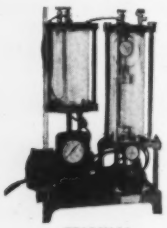

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Capacities to 3,000 lbs.

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Testing Machine Co.
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. . . accurate easy to read

PARSHALL MEASURING FLUME

For open channels in industrial plants, waterworks, irrigation systems and sewage disposal plants. Galvanized steel.

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- Easy to read
- Low head loss
- Throat widths: 3" to 10'

AUTOMATIC CONTROL GATES

Regulate flow and water levels regardless of water supply variation. Ends need for 24-hour supervision . . . prevents waste, flood damage and overflow. No floats, sheaves, motors or cables.

WELL CASING Scientifically designed for all soil conditions. Made of mild, stainless and alloy steels for long life and low initial cost. Five perforations and four field joints for fast assembly. Write for free literature.

TPO-1

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Ditcher & Trailer Build Irrigation System

ONE OF THE WORLD'S largest ditching machines and a special trailer to move it are part of the equipment used by Cameron County Water Control and Improvement District No. 1 to build a new irrigation system for ranchers and growers in Texas.

Rated at 28 cu yd a minute, the Gar Wood Buckeye Model 330 weighs 128,000 lb. As it was too heavy for ordinary hauling devices, Martin Trailer Division built a unique four-axle, 16-wheel unit with capacity to move the machine over ordinary highways without causing pavement damage. A Model RF8TL-4, the trailer is a Folding Gooseneck design, 38-ft long and 12-ft wide. For loading and unloading, the trailer's gooseneck lowers into a loading ramp that allows the huge ditching rig to be "walked" directly onto the platform. The unit can be loaded and ready for the road in 20 minutes; unloading is even faster, for 10 minutes after the rig arrives at a job site, the ditcher is ready for business. **Martin Trailer Division, Hyster Company, CE-3, 2905 N.E. Clackamas St., Portland, Ore.**

Build Irrigation System

Helicopter Saves Time

THE LOGISTICS INVOLVED IN transporting 34,500 lb of equipment four miles to the location of a new exploration mine shaft in the mountains of Southern Alaska were solved by a helicopter that weighs only 1,700 lb, empty. The 305-hp Hiller 12E delivered the cargo in one day, 8 hours, 25 minutes flying time, saving days of packing to the 4,100 ft site.

The more powerful twin of the U.S. Army's H-23D Raven, the 12E was also used to taxi three 2-man prospecting teams along their grids. Each of these teams, which were sometimes equipped with a 150-lb portable drill, was leapfrogged along the traverses over the 5,000-ft mountainous plateaus. Every team carried exploration equipment and food totaling almost 500 lb in addition to survival gear, pilot, passengers, and more than 20 gal of gasoline. **Hiller Aircraft Corporation, CE-3, Palo Alto, Calif.**

Voids Cut Concrete Use

AMONG THE NOVELTIES INTRODUCED into the Auditorium of Pittsburgh and Allegheny counties in Pittsburgh, Pa., was a roof that can be rolled back in warm weather to change from a closed auditorium to an open-air one.

The basic construction is unusual as over nine miles of tubular voids were used, resulting in a 50% saving in concrete. Some 44,000 lineal ft of 11½-in. od voids made up the bulk of the voided area. **The Richkraft Company, CE-3, 510 N. Dearborn St., Chicago, Ill.**

the bigger your pumping problems... the better your reasons for giving them to **WHEELER-ECONOMY**

At the Owyhee Irrigation Project, Homedale, Idaho, the problem was four high-capacity pumps which would move water from the Snake River to an irrigation canal 180 feet above. C.H. Wheeler solved it with the 30" x 24" Double-Suction Pumps shown here, each rated at 19,000 gpm, and two 36" x 24" Double-Suction Pumps rated at 19,700 gpm.

With nearly three-quarters of a century of pump design and manufacturing experience, C.H. Wheeler is well qualified to solve pump problems of any size and any degree of complexity.

Applications include flood control, irrigation, drainage, water supply and condenser circulation. Capacities of Wheeler-Economy Pumps range from 50 to more than 220,000 gpm.

See your Wheeler-Economy representative or write direct for information on centrifugal, axial or mixed flow pumps custom made for any high-capacity need.

Economy Pump Division

C. H. WHEELER MFG. CO.

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Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Steam Jet Vacuum Equipment • Marine Auxiliary Machinery • Nuclear Products

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EQUIPMENT MATERIALS and METHODS

(continued)

New Joint-Forming Method

A NEW METHOD OF forming joints in concrete pavement has won widespread acceptance. The insert called "Unitube" is a hollow strip of lightweight galvanized steel. The top is ⅜-in. wide. The 2¼-in. sides taper together at the bottom to permit easy insertion into the wet concrete. Each of these flanges turns outward and upward at the bottom to form a claw, imbedding each side of the flexible metal insert to a slab so that it spreads when

Lightweight Galvanized Steel

cracking occurs. Ten-foot lengths interlock end-to-end to form the longitudinal or transverse joint.

A two-man crew works from a specially designed rig, dubbed "The Planter", which has a vibrating "T-Bar" to form a groove in the fresh concrete and then push the Unitube to the proper depth. The ⅜-in.-wide flat top is left flush with the finished surface. A one-man operated mechanical vibrating machine called a "Crimper" is run down each joint, after the curing period, folding the top of the metal tube inward and downward. This produces a joint ½-in. deep to carry the sealing compound. Sealing is accomplished by normal methods, except that less material is required to provide a water-tight joint with the permanent Unitube in place, and the operation moves faster. **Highway Information Services, CE-3, 824 Colorado Bldg., Washington 5, D.C.**

Falsework Replaces Piling

THE FIRST STATE-APPROVED application in Minnesota of steel shoring to support the pouring of bridge slabs was by Industrial Construction Co., who used Waco Hi-Load Shoring as falsework on a separation bridge extending from a street in Red Wing to the main bridge span.

The shoring consists of standard 4-ft wide panels of high carbon steel tubing, each of which carries a load of 20,000

(Continued on page 139)

IT'S HANDY...
weighs only 9 oz.; 2¾" x 3" x 1⅛"; easy to carry in pocket, on belt, in car.

IT'S VERSATILE...
Ideal for preliminary and supplementary surveying; used as a compass, transit, level, plumb, alidade, clinometer.
Shows direction to 1°; level, slope or grade within 1°.

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"Over 60,000 Brunton Transits since 1896"
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UNDERPINNING
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CHICAGO 221 NORTH LaSALLE ST
WASHINGTON, D. C. TOWER BLDG.
PITTSBURGH EMPIRE BLDG

EQUIPMENT MATERIALS and METHODS

(continued)

lb, together with various types of shore heads, screws, staffs and other accessories. On the job site, the panels can be quickly and easily joined together in "towers" or combinations through use of the company's patented Speedlock and steel cross bracing. **Waco-Porter Corp., CE-3, 3563 Wooddale Ave., Minneapolis 16, Minn.**

High-Speed Ditcher

ORIGINALLY DESIGNED, AND until now, produced exclusively under contract for the U.S. Army Corps of Engineers, the Model 750 Ditcher has been released for purchase to civilian users.

Under development for seven years, it is a high-speed, heavy-duty, pneumatic tired vertical boom machine, digging up to 2-ft wide and 6-ft deep. Tested and operated at temperature ranges from 125 deg above zero to minus 32 deg, it has proved itself capable of high speed excavation in the most difficult materials, including Caliche and Coral Rock as well

Model 750

as in all more normal soil conditions including muddy ground.

The diesel-powered machine weighs 36,000 lb and is mounted on heavy-duty pneumatic tires. Operating principle of the vertical boom is to move a chain of linked buckets at high speed, cutting through hard material with an action similar to a milling machine working in metal. Each bucket is designed to be self-cleaning so that, in addition to fast digging in hard rocky soils, it is equally efficient in sticky mud. **Barber-Greene Company, CE-3, 400 N. Highland Ave., Aurora, Ill.**

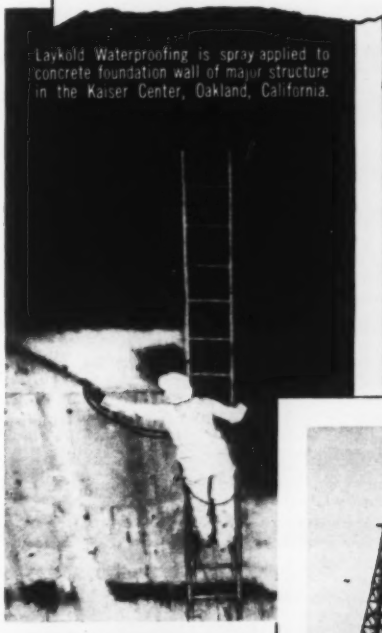
New Exitway

A NEW EXITWAY FOR passenger conveyor belt systems, providing the ultimate in safety and ease of entry and departure,

(Continued on page 140)

These Laykold® Products Keep Walls and Slabs DRY!

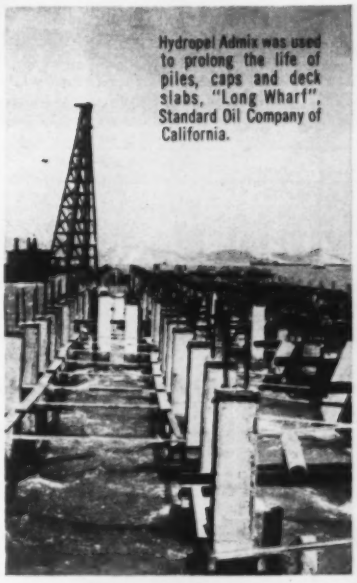
ASPHALT SPECIALTIES



Laykold Waterproofing is spray applied to concrete foundation wall of major structure in the Kaiser Center, Oakland, California.

LAYKOLD WATERPROOFING...

for fast, economical "first-line" protection. Laykold® Waterproofing* is a specially-compounded asphalt emulsion for cold, external application on concrete or masonry walls. Put on by brush or spray ahead of backfills, it provides resistance to moisture and dampness.



Hydropel Admix was used to prolong the life of piles, caps and deck slabs, "Long Wharf", Standard Oil Company of California.

HYDROPEL INTEGRAL ADMIX...

a unique type of asphalt emulsion for waterproofing* concrete used in walls, slabs, footings, etc. for industrial, marine or other construction.

Whenever moist conditions, freeze-thaw cycles, the presence of alkaline or neutral salts require the absolute minimum of moisture absorption, always specify Hydropel®. It cuts capillary water absorption by 80 per cent.

Waterproofing and Hydropel are only two of the famous Laykold line of asphaltic products available to the construction industry. Call or write our nearest office today for full information.

*The limitations of any product to "waterproof" any type of surface for an indefinite length of time are clearly recognized, as covered by the "Trade Practice Rules for the Masonry Industry," outlined 8/31/46 by the Federal Trade Commission.

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BITUMULS Emulsified Asphalts • CHEVRON Paving Asphalts • LAYKOLD Asphalt Specialties

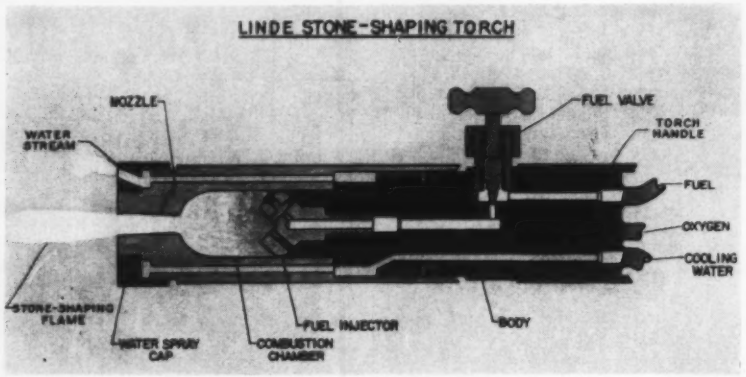
has been developed in cooperation with conveyor belt engineers of the Goodyear Tire & Rubber Co.

The new design incorporates a combing plate composed of tiny fingers that ride in grooves of the special ribbed passenger conveyor belt and "comb out" any object that might otherwise tend to get caught. **Stephens-Adamson Mfg. Co., CE-3, Aurora, Ill.**

Syntek Panel

A NEW CONCEPT IN panel manufacture, The Syntek Panel, involving the use of formed colored Plexiglas facing on certain types of insulating panels incorporated into the company's Series 969 Curtain Wall, has been announced.

This development gives architects and their clients a greater range of creativity in building design. Twenty-two colors, for example, have been approved for application. The architect can now create and obtain panels in a customized contour design to give his client distinctiveness and originality and to achieve outstanding design effects. **The Alumiline Corporation, CE-3, Dunnell Lane, Pawtucket, R. I.**



New Stone-Shaping Torch

SMALL ROCKET-JETS OF flame similar to large afterburner flames of jet planes can now be used to carve and shape stone five times faster than mechanical methods. Traveling six times faster than the speed of sound and reaching temperatures of 5550 deg F, the rocket-jet flame spits out of a small manual torch known as the Oxweld FSJ-6 Stone-Shaping Torch, which weighs slightly over 7 lb and is only 37 in. long. Oxygen fuel and cooling water enter through the back end of the torch; fuel and oxygen are mixed at the injection point and ignited in the combustion chamber to produce the flame. **Linde Company, Division of Union Carbide Corp., CE-3, 30 East 42nd St., New York 17, N. Y.**

(Advertisement)

Industrial Movie Wins National Acclaim

Smith & Loveless Motion Picture on Factory-Built Lift Stations Applauded by Engineers, Contractors—Award at NAHB Show

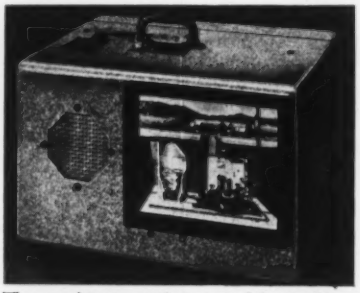
The first industrial movie program of Smith & Loveless, Lenexa, Kansas, has been applauded by busy engineers, contractors, builders and city officials, according to "Comment Cards" filled out by viewers all over the United States and Canada.

Busy engineers enjoy the convenience of watching the Smith & Loveless movie in their own offices.

The movie on factory-built sewage lift stations was recently cited for "Exceptional Merit" in the national "Ideas for Home Builders" contest. The award was presented at the Home Builders Show in Chicago. The contest judges gave special praise to their method of showing the movie to prospective customers via a special-built, continuous projector which requires no external screen, no rewinding or rethreading of the film. The projector, called a Cinesalesman, looks like a portable television set and is ideal for office calls on busy executives.

Movie Features Plant Tour

The color-sound movie emphasizes the manufacture, operation, design features and installation of Smith & Loveless factory-built sewage lift stations, used in municipal and suburban developments to raise sewage to a higher level or treatment facility. It includes a complete tour of the world's largest lift station manufacturing plant, located near Kansas City.



The continuous projector used by Smith & Loveless sales representatives.

Special Showings Arranged

Copies of the award-winning film are available for meetings and classroom use. Special showings can be arranged by contacting **Department 80, Smith & Loveless, Division—Union Tank Car Company, Lenexa, Kansas.** 2489

EQUIPMENT MATERIALS and METHODS

(continued)

Utility Field Houses

TWO STURDY ALL-STEEL utility buildings have been designed for building and construction crews' field houses. Both prefabricated buildings provide the safest and surest safeguard for tools and equipment and are economical and easy to erect, making the most practical worksheds for any job. They can be readily dismantled for moving to another job site.

The 7 ft x 7 ft Stor-House provides an ideal contractor's field house for any construction job. Wide 4-ft double doors give easy accessibility to tools and supplies stored within. Two handy pegboards are included on which to hang tools and implements. A ventilating window and door-top louvres permit free flow of air to eliminate mustiness and dampness. It is fireproof and rust-resistant. Compact and convenient, the building comes complete in pre-punched sections ready for speedy assembly with ordinary tools. If larger space is needed, extender sections of 2 ft each are available to give additional length as required. **Martin Steel Corporation, CE-3, Mansfield, Ohio.**

Probond Epoxy Solves Runway Repair Problem

MAJOR HEAVY-TRAFFIC AIRPORT runway repairs have posed a perplexing problem for both military and civil authorities for many years, particularly since the introduction of major-tonnage, high-speed aircraft. Essentially, the question has been how to maintain uniform tensile strength between the old and repaired sections, especially at the point where they are joined.

The problem found solution recently at Forbes Air Force Base, Topeka, Kansas, with the use of non-shrinking, high-strength Probond Epoxy, a steel and concrete adhesive. Extensive base runway repairs were effected using Probond Epoxy for dowel grouting in which the steel joining dowels were set into horizontal holes drilled into the old runway sections and permanently bonded with the Epoxy compound. Permanance of the bond was established in extensive tests which revealed that the bonds are 10 times stronger than concrete tensile strength, 4 times stronger than concrete on compressive strength tests, and 50 times stronger than concrete on impact strength tests and out of which there were no bond failures on compressive shear tests.

The company states that Probond Epoxy PC-150 which was used in the dowel grouting has averaged 2½ times the

(Continued on page 142)

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UNDISTURBED SAMPLES
FROM DIFFICULT FORMATIONS

ACKER-DENISON CORE BARRELS

THE ACKER-DENISON CORE BARREL PERFORMS WHERE OTHERS FAIL

The ability of the Acker-Denison Core Barrel to obtain **undisturbed samples** from sand, hard clays, silt and other difficult cohesive soil conditions accounts for its worldwide acceptance by Soil Engineers.

ACKER-DENISON CORE BARREL —PROVED AND IMPROVED

While the basic features of the original Denison are duplicated in the samplers manufactured by Acker, numerous improvements suggested by Acker's 40 years of soil sampling experience are incorporated in the new Acker-Denison. It is these improvements that make the Acker-Denison even more useful and efficient than before!

Remember, no other manufacturer can offer the improved performance and exclusive patented features of Acker's new Denison Core Barrel. This proud achievement of Acker development and progress is exclusively Acker!

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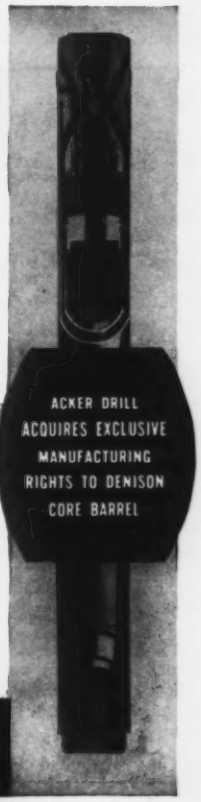

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Edo

World Leader in Hydrography

Edo Model 255C Survey Depth Recorder gives permanent bottom readings on over-lapping range scales.

EDO, PIONEER IN THE DESIGN AND DEVELOPMENT of sonar equipments for military and commercial use, manufactures three outstanding units to satisfy every hydrographic requirement.

EDO MODEL 255C SURVEY DEPTH RECORDER. Portable equipment for permanent or temporary installation aboard vessels of every size. Extremely accurate and easy to operate. Model 255C is the ideal recorder for depth, penetration and general underwater survey in water depths from 1½ feet to 230 fathoms. Weighs only 55 lbs.

EDO MODEL 400 STRATAGRAPH. Unique new sonar penetrates and records strata formations underlying beds of rivers, lakes and coastal waters. Narrow transducer beamwidth provides exceptional depth and layer definition. Sediment, intermediate layers, bed rock and faults are graphically recorded on eight over-lapping range scales, 0 to 250 fathoms, and on CRT display.

EDO MODEL 185 DEEP DEPTH SOUNDER. AN/UQN-1D. Developed by Edo for the U.S. Navy and now available commercially. Model 185 gives clear indication of depth from 0 to 6,000 fathoms. CRT indicator gives depth readings on two scales; recorder charts on three scales. No comparable equipment has ever before been produced in such quantity.

For technical details on these fine Edo hydrographic units, write to Dept. V-1

Edo CORPORATION, College Point, L. I., N. Y.

(continued)

strength of class A concrete, is extraordinarily wear-resistant, requires no particular skill to apply, and can be quickly cured by the use of artificial heat; it has been established that the product is immune to cyclical freezing and thawing. **Autolene Lubricants Co., CE-3, 1331 W. Evan Ave., Denver, Colo.**

Laminated Safety Glass

A GLASS WHICH BECOMES "limp" when broken, instead of shattering into flying fragments, has been proposed for windows of industrial control rooms and other structures exposed to hazards of explosions.

The glass, called laminated safety glass, is made by sandwiching a tough, resilient plastic film between two sheets of glass. It is the same kind of safety glass which has been used for a number of years in automobile windshields by all U.S. manufacturers.

Photographic data reveals that laminated safety glass, unlike other types of safety glazing, becomes "limp" under serious explosive conditions and folds safely from the window. It breaks but does not shatter because the pieces are held together by the plastic interlayer, which reduces the hazard of flying glass which caused 80% of the casualties during World War II air raids. It also resists the impact of flying objects and acts as a shield for the occupants of buildings. **Monsanto Chemical Co., CE-3, 800 North Lindbergh Blvd., St. Louis 66, Mo.**

Carterfone

A NEW ELECTRONIC DEVICE for use with two-way mobile radio communications systems is now being manufactured. The device, known as "Carterfone", when wired into a base station or remote control, allows the operator of the private two-way radio equipment to talk from a mobile unit into any public telephone service, local or long distance. In effect, it places a telephone in each two-way radio equipped vehicle.

The "Carterfone" is completely transistorized to permit instantaneous switching from broadcasting to receiving without the use of on-and-off switches. It requires no additional installation in mobile units whatever. An auxiliary speaker is provided with the unit and base control operator can hear when conversation ends. **Carter Electronics Corp., CE-3, 6762 Greenville Ave., Dallas 31, Texas.**

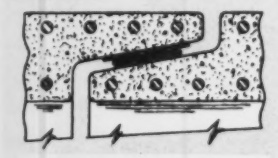
Dry-Mix Cement Compound

A NEW PRODUCT FOR concrete finishing and patching, Larsen-Mix is a one-component, dry-mix cement compound to which the user simply adds water, mixes, and trowels on to the surface to be finished or patched.

When troweled on any clean, structurally sound surface, it produces a smooth, durable, very strong and tenacious patch. The new product has a tensile strength of 1,100 psi; a compressive strength of 4,600 psi; and a bond strength of 490 psi.

Ideally suited for thin toppings to poured concrete slabs and for repairing concrete floors, steps, walls, ramps, sidewalks, driveways, and swimming pools, it is also excellent as an underlayment on floors that are to receive resilient floor materials. **Larsen Products Corp., CE-3, Drawer 5938, Bethesda 14, Md.**

Leak-proof **"for the life of the line"...**



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TYLOX
Rubber
PIPE GASKETS

Heavy-duty, acid-resistant, *flexible* TYLOX Gaskets are made for large bore tongue and groove pipe. They are quickly "snapped on" to the pipe, and the pipe quickly coupled into the line. TYLOX reduces construction costs by speeding pipe coupling, and forms a compression seal that stays tight for the life of the pipe. TYLOX reduces treatment plant costs by preventing infiltration. REXON No. 2 PIPE COATING is a synthetic hard rubber which vulcanizes to pipe by catalytic action, *not* by evaporation which causes pin-holes. REXON No. 2 protects concrete pipe from deterioration by hydrogen sulphide gas, oils, greases and solvents. WRITE FOR MORE DETAILS.

HAMILTON KENT MANUFACTURING CO.
Kent, Ohio *ORchard 3-9555*
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Combined Index

A publication that includes the 1959 indexes for Transactions, Civil Engineering, and the Division Journals is now available at a list price of $2.00; ASCE members are entitled to a 50% discount. This publication is identified as ASCE publication 1960-10 and can be ordered by use of the coupon herewith.

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Sewage Regulator

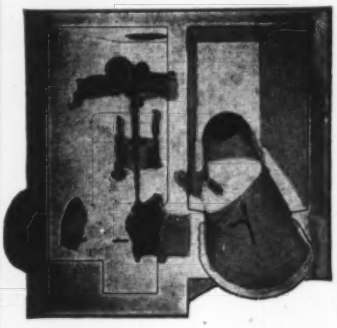

Fig. B-19

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Films Available

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"INSULATING WITH PLASTIC"—This 35-mm film which runs 18 minutes traces the recent development of flexible, foamed plastic insulation, describes its properties, and shows a number of application techniques used in actual installations. Approximately 45 case histories of all kinds of jobs in the air conditioning, refrigerating and plumbing and heating fields are shown in the film. **Armstrong Cork Co., CE-3, 1010 Concord St., Lancaster, Pa.**

"PAVING MODERN CONCRETE HIGHWAYS"—A new 16-mm color film depicts base laying; form setting; subgrading; cement and aggregate batching; paver, spreader, and finisher operation; form stripping; and shoulder widening. Case history reports provide background information. Taken during paving operations of the John C. Peterson Construction Corp. section of the Illinois Toll Road, the film is available to engineers, contractors and civic groups. **Blaw-Knox Co., CE-3, 300 Sixth Ave., Pittsburgh, Pa.**

FIRESTOPPER ROOF DECK—This 16-mm, color picture is beamed at architects, engineers and roof deck applicators. Entitled "Bestwall Firestopper Poured Gypsum Roof Decks", the picture illustrates the use of the various components of the roof deck: Metro-Mix, steel reinforcing wires and gypsum formboard, to form a rigid monolithic unit which can be tailored to meet the architect's exacting requirements. **Bestwall Gypsum Co., CE-3, 120 E. Lancaster Ave., Ardmore, Pa.**

"CRAWLER TRACTORS IN ACTION"—Earthmoving methods before the machine age, and the story of earthmoving equipment from its inception to the present time, are highlighted in this 20-min 16-mm motion picture. The new movie takes the viewer to job locations and graphically illustrates the multitude of construction, earthmoving, and material handling jobs the equipment can handle efficiently and economically. **Allis-Chalmers Mfg. Co., CE-3, 864 S. 70th St., Milwaukee, Wis.**

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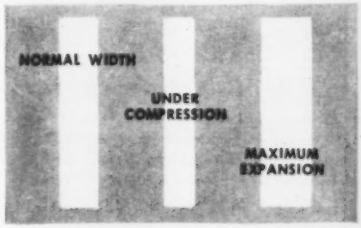

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Literature Available

INSTRUMENTATION OF WATER TREATMENT PLANTS—Methods for automatic control of water treatment plants are discussed in Technical Reprint T-179, which is entitled "Instrumentation of Water Treatment Plants." Part I deals with control of demineralization plants and covers a wide range of subjects including "stepless" regeneration, quality control of effluent, conductivity, ph control, automatic regeneration, and the use of multiport and piston-operated valves. Part II considers control of cold process softening and clarification units, hot process-hot zeolite systems and sodium zeolite systems. **Graver Water Conditioning Co., CE-3, 216 W. 14th St., New York 11, N. Y.**

STRUCTURAL PLASTICS—An illustrated 12-page brochure describing the use of reinforced structural plastics in the Uniparr Screen Assemblies for water intake gates of steam power plants has been made available. The engineering details on the specifications for these $26\frac{1}{2}$ x 16-ft water gates include the flexural and tensile strengths and the high modulus of elasticity which make possible the wide variety of structural applications. **CTL, Division of Studebaker-Packard Corp., CE-3, 1240 Glendale-Milford Road, Cincinnati 15, Ohio.**

METAL CURTAIN WALL MANUAL—The principal purpose of this Metal Curtain Wall Manual is to provide the architect with a file of useful and reliable technical information on metal curtain wall design and performance. Included in it are sections on terminology, bibliography, general specifications, performance standards, design criteria, materials and finish standards and testing procedures. Prepared in looseleaf form, it can be regularly revised and kept up to date. **National Association of Architectural Metal Manufacturers, CE-3, 228 North LaSalle St., Chicago 1, Ill.**

PROGRESSIVE CAPACITY BATCHING—A "building block" concept that increases batch plant production from 250 to 800 cu yd per day is featured in a new 8-page Engineering Reference and Data Manual. Called "Progressive Capacity Batching", the process allows the small contractor to build a complete plant layout, piece-by-piece, around the company's portable batching unit, increasing batching capacities without discarding useful equipment along the way. **The Boardman Co., CE-3, P. O. Box 1152, Oklahoma City 1, Okla.**

NEW FORMING CATALOG—A 12-page catalog describes the latest design of Lifetime Steel Forms for concrete construction. It illustrates simple design that saves time, labor and materials and shows how forms are easily locked together with just a twist of a clamp. It also pictures various form set-ups for curved walls, tapered walls, tunnels, columns, corbels and offsets as well as simple walls. **Economy Forms Corp., CE-3, 128-G, Highland Park Station, Des Moines, Iowa.**

WHITE CONCRETE REFLECTING CURBING—A 12-page booklet covering the use of Atlas White portland cement in constructing corrugated reflecting curbing and markers for highways, roads and streets is available. It illustrates the use of this reflectorization system, outlines typical installation methods and presents detailed drawings. **Universal Atlas Cement Division, U. S. Steel Corporation, CE-3, 100 Park Ave., New York 17, N. Y.**

METAL LATH SPECIFICATIONS—A 20-page booklet entitled "Specifications for Metal Lathing and Furring" is available, which contains fire-resistive ratings, design tables, and specifications for hollow partitions, solid partitions, sound insulating partitions, ceilings, vertical furring, and centering. Sections relating to materials and corner joint reinforcement are also included. **Metal Lath Manufacturers Association, CE-3, Engineers Building, Cleveland 14, Ohio.**

CONCRETE BEAM DESIGN PROCEDURE—Data Sheet PC 946 "Design Procedure for a Simple-Span Prestressed Concrete Beam" is now available. Based on ACI-ASCE Committee 323 Report "Tentative Recommendations for Prestressed Concrete," this procedure is an excellent guide for engineers in the design of prestressed concrete members. **John A. Roebling's Sons Division The Colorado Fuel and Iron Corp., CE-3, Broad and Neroni Sts., Trenton 2, New Jersey.**

TRUCK CRANE—A new 16-page catalog describing the many exclusive features of the 60-ton truck crane has been released. Actual illustrations are shown taken on large engineering projects and big lifts. **American Hoist & Derrick Co., CE-3, 63 South Robert, St. Paul, Minn.**

EDGE-PUNCHED CARDS—When to use edge-punched cards to expedite data-processing is the subject of a new, illustrated brochure. It also describes one of the latest advances in paperwork automation—the Electronic Synchro-Tape Typewriter. Although this equipment is equally efficient with either punched-tape or edge-punched cards, it is the latter which the brochure emphasizes. For example, when data is filed, used, and refiled repeatedly, edge-punched cards can provide the speed and accuracy required for efficient processing. **Remington Rand, Division of Sperry Rand Corp., CE-3, 315 Fourth Ave., New York 10, N. Y.**

From the MANUFACTURERS

INSTITUTE FORMED: Ontario manufacturers of centrifugally cast concrete products have recently formed the Centrifugally Cast Concrete Institute, which has as objectives promotion of the use of centrifugally cast concrete products, standardization and continued improvement of design, an exchange of practical knowledge among its members and to secure efficient co-operation with associated industries and government agencies . . . **MERGERS ANNOUNCED:** The Rex Corporation has been merged with William Brand & Co. of Willimantic to form the William Brand-Rex Division of American Enka Corporation . . . Challenge Manufacturing Co., manufacturers of the Challenge Pacemaker Truck Mixer and Cook Bros. Equipment Co., manufacturers of heavy duty trucks and truck equipment for the construction industry and world-wide distributors for Challenge Truck Mixers, have merged into one corporate group to be known as Challenge-Cook Bros. . . . **TRUCK PARTS DEPOT:** The International Harvester Company will construct a new motor truck parts depot on a 30-acre site located at the intersection of the Meyer and Moeller Roads, directly south of the company's Fort Wayne motor truck engineering department and laboratories . . . **SUBSIDIARY FORMED:** Soiltest, Inc., Chicago, has announced the organization of a subsidiary, Soiltest International S.A. of Lausanne, Switzerland, which will direct sales and distribution for the company's European, African and Middle Eastern markets . . . **NEW PLANT:** Construction of a new plant to produce Dicalite filteraids and mineral fillers for continental and northern European markets is underway in Ghent, Belgium, according to the Great Lakes Carbon Corporation . . . **CONSOLIDATED UNIT:** The Westinghouse Air Brake Company has announced that its Le Roi Division operations in West Allis, Wisconsin, Greenwich, Ohio, and certain functions of its Cleveland, Ohio, plant will be consolidated into one operating unit which will be established at Sidney, Ohio. The new unit will begin operations in the early spring of this year . . . **NAME CHANGE:** The stockholders of The Sight Feed Generator Co., West Alexandria, Ohio, voted to change the name of the firm to Rexare, Incorporated . . . **NEW ACQUISITION:** C. H. Wheeler Co. has announced the acquisition by its parent company, Hamilton-Thomas Corporation of Hamilton, Ohio, of major interests in Griscom-Russell Co., Massillon, Ohio, and Smart-Turner Machine Company, Ltd., Hamilton, Ontario, Canada . . . **SOLAR PRISM:** Wild-Heerbrugg, Port Washington, N. Y. announces it has obtained manufacturing and distribution rights for the Solar prism developed in Holland by Professor Roelofs . . . **CREATES PAVING BUREAU:** The Portland Cement Association has announced the merger of its Highway and Municipal and Soil-Cement Bureaus into a single Paving Bureau . . . **DISTRIBUTORS APPOINTED:** The Dalworth Machinery Company of Dallas, Texas, has been appointed as distributor for the complete line of LeTourneau-Westinghouse earthmoving, grading and heavy hauling equipment in the Dallas area . . . The Overton Sales-Equipment Company, San Diego, Calif., will assume the responsibility for the line of Detectron utility instruments manufactured by Computer Measurements Company, Sylmar, Calif. . . . Unit Crane & Shovel Corp., Milwaukee, Wisconsin, and Steel & Company, Ltd. of Sunderland, England, one of the world's largest manufacturers of cranes, have completed arrangements, giving Unit distribution and manufacturing rights under license, for the famous line of Coles all-electric, gas or diesel driven mobile cranes, in the United States, Canada, and Mexico . . . **APPOINTMENTS:** Robert G. Betts has been elected president of W.&L.E. Gurley of Troy, N. Y., one of America's oldest manufacturers of engineering and scientific instruments . . . J. M. Hultz, General Manager of the Simplex Valve and Meter Co., a division of Pfaudler Permutit Inc., has announced that R. A. McQuade has rejoined the company as the Assistant to the General Manager . . . Howard Mark has been named a Programming Instructor for Bendix Computer Division. He will be stationed at the company's West Coast training school in Santa Monica, Calif.

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PROCEEDINGS AVAILABLE

January

2349. Discussion of Proceedings Paper 2058, 2079, 2081, 2084, 2126. (HY) Leo L. Burnet on 2058. Raphael G. Kazmann on 2079. F. V. A. Engel, P. Ackers, Nicholas Bilonok, John A. Roberson on 2081. L. L. Weiss on 2084. John B. Herbich on 2126.

2350. Stability Considerations in the Design of Steel Plate Girders, by Charles E. L. Massonnet. (ST) The paper deals with the results of tests conducted on large steel plate girders. Particular consideration is given to the stability requirements of webs and stiffeners of large-scale steel girders. Different combinations of bending and shear are considered.

2351. New Aspects Concerning Inelastic Instability of Steel Structures, by Brune Thurlimann. (ST) This paper was the basis for an oral presentation at the Joint ASCE-IABSE Meeting at the New York Convention, October, 1958. All Joint Meeting papers published in Proceedings or in Civil Engineering will be reprinted in one volume.

2352. Discussion of Proceedings Paper 1930, 2062, 2090. (SA) Conrad P. Straub closure to 1930. Frank D. Masch on 2062. Shuichi Aiba, James J. McKeown and Daniel A. Okun on 2090.

2353. Discussion of Proceedings Paper 1815, 1837, 1914, 2218, 2239. (ST) Henry Malter closure to 1815. H. L. Murphy corrections to 1837. D. Y. Fok and Tung Au closure to 1914. Ray W. Clough, Stevens J. Fenves on 2218. Robert F. Borg on 2239.

2354. Torsional Analysis of Suspension Bridge Towers, by Frank Baron and Anthony G. Arioto. (ST) An analytical procedure is presented for determining the moments, shears, and displacements of suspension bridge towers that are subjected to a torque about their longitudinal axes. Numerical examples are given to illustrate the procedure.

February

Journals: Construction, Hydraulics, Power, Soil Mechanics and Foundations, Structural, Surveying and Mapping.

2355. Fundamentals of Arctic Blasting, by Clifton W. Livingston. (CO) The behavior of materials in blasting may be classified into 1) the shock type, 2) the shear type, or 3) the viscous damping type. Blast effects are determined by examining the relation between the energy of the explosion and the mass of the material to which the energy is transferred.

2356. New Tools and Techniques for Dewatering, by Byron J. Prugh. (CO) Description of the use of present day dewatering tools including conventional wellpoints; high-lift systems with ejectors, submersible or turbine pump units; sand drains, and grout curtain walls. Construction job examples of the use of contemporary dewatering tools.

2357. Field Office Bookshelf, by Morton D. Morris. (CO) Every other year Contractors and Engineers publishes a revised bibliography, listing books recommended and suggested for a Field Office Bookshelf. The lists, reviewed and brought up to date, are presented herewith for the information and use of the Construction Division.

2358. Polyvinyl Acetate and Portland Cement Mortars, by Robert T. Howe. (CO) Polyvinyl acetate, offers some promise as an admixture for portland cement mortars. This paper examines polyvinyl acetate and outlines research concerning its possible use in a concrete floor surfacing material.

2359. Control of Ground Water in Excavations, by W. F. Swiger. (CO) This paper presents a review of the basic methods of controlling ground water in excavations. The factors evaluated in selecting a water central system, the methods available, their advantages and disadvantages, and principles of design are discussed.

2360. Epoxy Resin for Structural Repair of Concrete Pavement, by Wilson L. Davis and Eugene Pinkstaff. (CO) This paper describes tests, performed in the North Central Division Laboratory of the Corps of Engineers, in formulating epoxy resins that will satisfactorily repair surface defects in portland cement concrete pavements, that will bond the hardened surfaces of concrete together, and that will bond new concrete to existing concrete.

2361. Prospecting for Thermal Power Plant Sites, by R. A. Elliot. (PO) This paper reviews experiences in the selection of sites for modern stations in the Tennessee Vally Authority power system. Special problems dealing with mapping, foundation explorations, and condenser water systems are described.

2362. Hydrologic Studies by Electronic Computers in TVA, by Willard M. Snyder. (HY) Application of electronic computers in TVA watershed studies is presented. A comprehensive multiple regression analysis program for the IBM 704 computer is described.

2363. Effective Length of Framed Columns, by Thomas C. Kavanagh. (ST) The assumption in many structural specifications that the effective length of columns is equal to the actual length may be extremely conservative in some cases and very hazardous in others. This paper reviews the current state of knowledge relating to effective lengths, and describes the rigorous procedures which permit a rapid selection of the proper effective length for design.

2364. Scales of Viscous Analogy Models for Ground Water Studies, by Jacob Bear. (HY) Scales for viscous fluid models used for studying various problems of flow through porous media are described. Consideration is given to model techniques and limitations. The presentation covers scales for length, time discharge, volume, storage coefficient, two liquid flows, and capillary effects.

2365. Self-checking Method of Computing Curve Elevations, by Charles M. Lamont. (SU) This paper describes a rapid self-checking method of computing vertical parabolic curve elevations, using the conventional type mechanical calculating machine.

2366. Boundary Layer Stimulation in Rectangular Conduits, by R. G. Cox and F. L. Bauer. (HY) The effects of artificial stimulation of the turbulent boundary layer were studied in a 0.283-ft by 0.5 ft plastic conduit. The length of conduit required for fully developed pipe flow was reduced from 18.5-ft to 14-ft by $\frac{1}{8}$-in. cubes cemented to the conduit entrance curves.

2367. The Calculating Machine in Coordinate Geometry, by Bela Vadasz. (SU) This paper systematizes the solution of common engineering problems in coordinate geometry. Surveying and layout computations, such as intersection, reverse

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curves, and the three-point problem are analysed and tabulated for solution on conventional calculators.

2368. Dynamic Testing of Pavements, by W. Heukelom and C. R. Foster. (SM) Each time a vehicle passes over a pavement the surface is deflected and rebounds, creating temporary strain conditions for 0.01 to 0.1 sec. Methods used for the dynamic investigation of pavements, base courses, and subgrades are described in the present paper.

2369. Scour at Bridge Crossings, by Emmett M. Laursen. (HY) Relationships are proposed for the prediction of scour at piers and abutments for the case in which sediment is supplied to the scour hole. The relationships were obtained from a combination of an approximate analysis and laboratory experiments, and depend on knowledge of the flow conditions at the bridge site.

2370. Electric Analog for Triangulation Adjustment, by Hsuan-Loh Su. (SU) Various methods based on the principle of electric analogy for triangulation adjustment problems are suggested. It is shown in one of the examples that for a triangulation involving 8 angle equations and 2 side equations, the adjustment problem can be solved by one operator within a few days.

2371. Sediment Transportation and Delta Formation, by E. Kuiper. (HY) This paper gives a description of the regime of the Saskatchewan River in general and the Saskatchewan Delta in particular. Sedimentation computations, carried out in connection with dike design for the Saskatchewan Delta reclamation project, are also presented.

2372. Control of Cracking in TVA Concrete Gravity Dams, by Walter F. Emmons, Olav Lavik and Poul L. Hornby. (PO) This paper outlines the methods used to control cracking of mass concrete in four of TVA's gravity dams. Included are descriptions of cracks observed during and after construction.

2373. Anchored Bulkhead Design by Numerical Method, by F. E. Richart, Jr. (SM) Newmark's numerical method for solving beam problems was used in the classical design procedures for anchored bulkheads. Direct solutions were obtained rapidly and easily by this method, as illustrated by examples.

2374. Trap Efficiency of Reservoirs, Debris Basins, and Debris Dams, by Charlie M. Moore, Walter J. Weed and Graham W. Renfro. (HY) An attempt has been made to review and summarize available information pertaining to trap efficiency and to make it available to the engineers and others in a unified form.

2375. Additional Aspects of the Enrico Fermi Atomic Power Plant, by N. L. Scott and R. F. Mantey. (PO) This paper outlines the unusual structural features of the first commercial fast-neutron reactor power plant. Details of shielding, shielding penetrations, and special construction methods required are presented.

2376. Strategic Aspects of Urban Flood-Plain Occupance, by Gilbert F. White. (HY) The paradox of continuing flood control and rising flood losses is explained in part by elements entering into decisions to change urban flood-plain occupance, 1936-1957. Curbing the mounting toll calls for public action to broaden the range of choice open to managers of flood-plain properties in adjusting to flood hazard.

2377. Discussion of Proceedings Paper 1955, 1959. (CO) David A. Day on 1955. C. H. Oglesby and John Fondahl on 1959.

2378. Airborne Surveying with Doppler Systems, by L. R. Chapman. (SU) Self-contained navigation systems based on the familiar "Doppler effect" provide precise, automatic direction of an aircraft over a pre-determined flight path, with accurate side-lap and over-lap control. The advantages are reflected in better accuracies and lower costs of Doppler survey operations.

2379. Intersection of Straight Line with Spiral, by T. F. Nickerson. (SU) In solving bridges or other structures along spiral curves connecting tangents with circles, the problem of locating the points of intersection of straight lines with the center-line base spiral and the outer and inner parallel spirals arises. By using the formulas with high-speed electronic digital computers, these intersections may be determined to a high degree of accuracy.

2380. Highway Location and Design by Photogrammetric-Electronic Computer, by S. E. Ridge. (SU) By combining photogrammetric techniques and electronic computers, the engineer is able to locate and design highways with economy and speed. Such equipment allows for a thorough study of the many alternatives available in highway design.

2381. Discussion of Proceedings Paper 1904, 2084, 2085, 2147, 2148, 2149, 2260. (HY) O. A. Johnson and P. B. Boyer on 1904. W. H. Sammons on 2084. R. Hugh Taylor and John F. Kennedy on 2085. Gordon R. Williams on 2147. M. H. Diskin on 2148. Manuel A. Benson and Marcel Bitoun on 2149. T. Blench on 2260.

2382. Design Pressure for a Reactor Containment Vessel, by J. A. Bailey. (ST) The basis for selection of the magnitude of the reactor accident against which the containment vessel must provide protection is presented, and a limiting accident is analyzed. A numerical example is shown, and generalized curves are included.

2383. The Stone Tower at Newport Speaks, by Edward Adams Richardson. (SU) The Newport Tower, of archeological interest, is investigated for structural design and to determine possible reasons for the window and fireplace arrangement. The design proves adequate, by modern standards, for a particular church structure, while the windows and fireplace form a sophisticated signalling and ship guidance system circa the 14th century.

2384. Properties of Steel and Concrete and the Behavior of Structures, by George Winter. (ST) The aim of this paper is to review, broadly, new findings on materials performance and structural behavior. These findings relate to plastic or inelastic materials properties, and to brittle fracture, fatigue, residual stresses, creep, strength under combined stress, actual versus specified strength, and the like.

2385. Discussion of Proceedings Paper 1842, 2166. (SU) Committee on Highway and Bridge Surveys on 1842. Carl F. Meyers on 2166.

2386. Surveying in the Civil Engineering Curriculum—Panel Discussion—for Education, by Kenneth S. Curtis. (SU) Current curriculum revisions toward a stronger basic sciences background will mean less emphasis on the art of engineering, and the new engineer will not be as productive upon graduation. However, he will be better equipped to successfully cope with the complex problems of the future and will eventually yield a greater contribution.

2387. Civil Engineering Curriculum for Federal Surveying and Mapping, by G. C. Tewinkel. (SU) The federal government has historically employed civil engineers in branches concerned with surveying and mapping. In recent years, however, recruitment efforts have fallen short of the necessary levels. The author presents reasons for this turn of events and analyzes curriculum requirements.

2388. Topographic Mapping in Alaska, by Reynold E. Isto. (SU) Alaska has presented many challenges to mapmakers, and is an opportune proving ground for the development of new and enterprising techniques. An example of Alaskan mapping projects is the Brooks Range Area. Alaskan mapping has been a joint effort of the Geological Survey, Coast and Geodetic Survey, and Department of Defense.

2389. Installation and Operation of Dewatering Systems, by David A. Werblin. (SM) The three principal types of dewatering systems—sumps, wellpoints, and deep wells—are described. Conditions under which each type may be used, and equipment and methods of installation are presented, together with methods of coping with some of the problems that arise in the field.

2390. Discussion of Proceedings Paper 1817, 1910, 1944, 2035, 2065, 2223, 2308. (ST) George S. Vincent on 1817. G. R. Swihart, J. R. Allgood and W. A. Shaw on 1910. Richard H. Bigelow on 2035. E. Y. W. Tsui on 2065. Gerald D. Galletly on 2223. Nat T. Kanarek on 2308.

2391. Discussion of Proceedings Paper 1864, 1937, 1999, 2000, 2001, 2135, 2136, 2137, 2211, 2214, 2215, 2217. (SM) E. Montford Fucik and R. F. Edbrooke on 1864. Philip Keene on 1937. A. W. Taylor on 1999. I. Th. Rosenqvist on 2000. William T. Lambe on 2001. Ralph B. Peck, H. O. Ireland, Clifton E. R. Lawson, Douglas R. Brown, William M. Crawford, Benjamin KOO, Alfred C. Sheer on 2135. Max Suter on 2136. A. A. Eremin on 2137. Edward A. Abdun-Nur on 2211. W. H. Gotolski on 2214. Ralph B. Peck on 2215. Marcel Bitoun and Jorgen Christiansen on 2217.

2392. Discussion of Proceedings Paper 1556, 1737, 1739, 1746, 1947, 2130. (PO) F. W. Scheidenhelm, John B. Snethage, and Arthur N. Vanderlip and G. R. Scott on 1556. I. C. Steele and J. B. Cooke, Karl Terzaghi on 1737. John B. Snethage, F. W. Scheidenhelm and Arthur N. Vanderlip on 1739. Karl Terzaghi on 1746. Walter J. Weyermann on 1748. J. F. Muir on 1947. Kenneth B. Keener on 2130.

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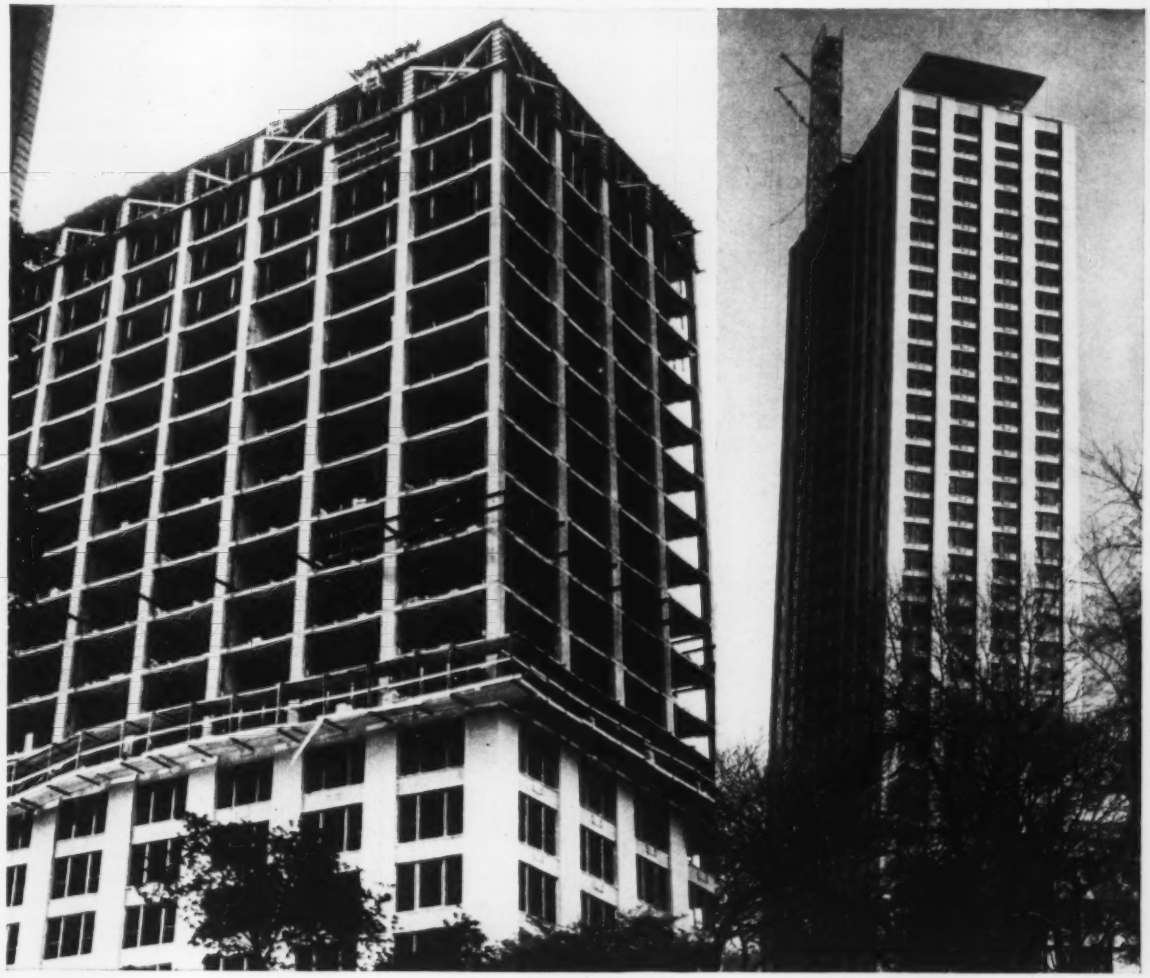

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